Technical Manual No.
799816-003
Revision G

MODEL F880 MAGNETIC TAPE TRANSPORT

VOLUME I

OPERATION MAINTENANCE

Cipher Data Products
10225 Willow Creek Road
San Diego, California 92138

August 1983

NOTICE

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions included in this manual, may cause interference to radio communications. Verification of compliance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference, is the responsibility of the installer.

VOLUME I

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

SECTION I

DESCRIPTION, UNPACKING, INSPECTION, AND INSTALLATION

GENERAL

1-1. The Model F880 Magnetic Tape Streamer Unit (MTSU) is a dual-speed, dual-density, tape transport manufactured by Cipher Data Products Inc., San Diego, California. It incorporates a dual-gap head, providing read-after-write capability. Read/write, control, and formatting electronics are all incorporated in a single printed-wiring board (PWB). The transport is designed to operate on 85- to 132-Vac or 195- to 263-Vac, single-phase, 48- to 61-Hz line power. Reels to 10.5 inches in diameter can be accommodated. Tape speed and density capabilities are as follows:

a. Model F880 MTSU (1600 bpi)

   (1) 25 ips at 1600 bpi

   (2) 100 ips at 1600 bpi

b. Model F880 MTSU (3200 bpi)

   (1) 25 ips at 1600 bpi

   (2) 50 ips at 3200 bpi

   (3) 100 ips at 1600 bpi

This section presents instructions for unpacking, inspecting, and installing the MTSU.

UNPACKING AND INSPECTION

1-2. The MTSU is shipped in a single carton reinforced by eight corner blocks to minimize the possibility of damage during shipping. Unpack as follows:

a. With shipping container on floor or workbench, cut side and center tapes securing top of outer box.

b. Pull box-top flaps down along sides of box. Lift upper foam corner blocks off MTSU, remove MTSU and place on table. Remove manual, I/O connector retainer, and rack latch bracket from shipping carton.

c. Check contents of shipping container against packing slip, and inspect for possible damage. **If damage exists, notify carrier.**

d. Refer to the illustration taped to the front door. Remove tape holding top cover and front door in place. Open top cover by lifting sides directly behind front panel. Place cover stay (left rear of top cover) in the slot provided. This is the maintenance access position. Pull tachometer (spring loaded arm at left-rear of unit) away from hub and discard the foam cushion. Carefully replace tachometer assembly against hub.

e. Examine the hubs, tachometer, and other components in tape path area for foreign matter.

f. Using a screwdriver, loosen two captive screws at front sides of top plate casting. Close the top cover. Lift front panel (and top plate casting) by grasping the two lower corners. Lift unit to its maximum upright position. Latch mechanism will automatically engage when unit is lowered approximately one inch. Insert the safety pin provided through both holes in the top plate support from outside inward (Figure 4-2). This is the service access position.

g. Remove 3 pieces of foam packing material from PWB. Check PWB and all connectors for correct installation.

h. To release latch mechanism, remove the safety pin and lift front panel before lowering it. Open top cover and tighten captive screws. Close top cover.

i. Do not replace packing tape or foam cushion materials.

j. Verify that the operating voltage indicated on the manufacturers label (rear of chassis) matches the power outlet voltage for the unit. If not, refer to paragraph 1-4 for instructions to change the operating voltage.

POWER CONNECTION

CAUTION

To prevent damage to the MTSU and ensure proper operation, be sure the outlet voltage is correct before applying power to the MTSU.

1-3. A power cord is supplied only for the voltage range indicated on the manufacturers label.

1-4. **Operating Voltage Selection.** The MTSU can be operated over a wide range of line voltages by selection of the appropriate power supply voltage option. To change the power supply option, proceed as follows:

CAUTION

When MTSU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of MTSU in extended position could upset an inadequately mounted equipment rack.

a. Switch transport power OFF and remove power cord from outlet.

b. Open unit to service access position. Refer to paragraph 1-2 (f).

c. Place a shop cloth or similiar item over the PWB in the area of the power supply assembly.

WARNING

Dangerous voltages can be encountered in the next two steps if the power cord is connected to an AC source or if the unit has had power applied in the last two minutes.

d. Refer to Figure 4-23. Remove two phillips head screws securing power supply cover, noting position of chassis ground cable. Pivot cover to the right and slide forward to remove.

e. Remove voltage selection card (4, Figure 4-24) from J9 on power supply PWB. Noting position of key slot on voltage selection card, reinstall the card in J9 to correspond to the desired voltage. Refer to Table 1-1.

f. Reverse steps c and d.

g. Replace the fuse, if required, with one of the correct current rating for the voltage selected. Refer to Table 1-1. Use a slo-blo, 250V type. The fuse holder is located on the right-front of the power supply assembly. Replace the power cord if required.

h. Adjust the +5V regulator circuit on the main PWB. Refer to paragraph 4-16.

i. Note in a prominent location on the unit that the "operating voltage (has been) changed to _____."

NOMINAL LINE VOLTAGE (TOLERANCE)	SELECTION CARD	FUSE (AMPS)	FREQUENCY (Hz)
100 - (85 - 110)	100	3.0	49-63
120 - (102 - 132)	120	3.0	49-63
208 - (187 - 228)	220	1.5	49-63
220 - (187 - 242)	220	1.5	49-63
230 - (207 - 253)	240	1.5	49-63
240 - (204 - 264)	240	1.5	49-63

Table 1-1. Operating Voltage Selection

INITIAL CHECKOUT

1-5. Section II contains a detailed description of all controls. To check for proper operation before installation, proceed as follows:

a. Connect power cord.

b. Clean tape path as directed in paragraphs 4-4 through 4-10.

c. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 2 seconds). For other indications refer to paragraphs 2-6 and 2-7.

d. Ensure that tape is wound completely onto reel.

CAUTION

Both top cover and front panel door are locked during tape-loaded functions. Any attempt to open either top cover or front panel door before tape is unloaded will result in mechanical damage to the locking mechanism.

e. Open front panel door by pressing down gently on top (center) of door.

f. Insert tape into front panel of unit with write-enable ring side down.

g. Close front panel door.

h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

i. Initiate Service Aid 22 as described in paragraphs 3-3 and 3-27. Allow transport to cycle tape for a sufficient length of time to ensure proper servo operation. (It requires about 30 minutes to make a full pass on a 10.5 inch reel and complete a rewind sequence).

j. Exit Service Aid 22. Refer to paragraph 3-4.

k. Check that LOAD indicator remains illuminated following rewind sequence.

l. Check ON-LINE switch and indicator by depressing repeatedly and observing that ON-LINE indicator is alternately illuminated and extinguished. Leave in OFF-LINE state (indicator extinguished).

m. Press UNLOAD switch. When the tape is unloaded (UNLOAD indicator illuminated) open front panel door and remove tape reel. Close front panel door.

n. Switch power off and remove power cord from outlet.

RACK MOUNTING

1-6. The MTSU is designed to be mounted in a standard, 19 inch wide, EIA equipment rack using the slides and mounting hardware provided with each unit. Refer to Figure 1-1 and drawing in Installation Hardware Package to mount the unit as follows:

a. Locate the front and rear rail holes to be used on the equipment rack (1, Figure 1-1). If they are threaded, drill them out to 0.281 inches.

b. Place the transport in service access position. Refer to paragraph 4-3.

c. Starting with either side, remove stationary section of slide (2) from transport by pulling stationary section to the front of transport.

d. Remove intermediate section of slide (3) from transport by pulling intermediate section to the rear of transport. When spring lock engages, depress to release.

e. Reassemble these sections by sliding front of intermediate section into rear of stationary section. Depress spring lock to slide completely together. Leave these sections assembled.

f. Determine, for the depth of rack, the appropriate holes to use in the mounting bracket and secure loosely to stationary section using two 10-32 X 3/8 binder head screws (4) and a nut plate (5).

g. Mount front flange of stationary section (2) to front rail by placing flange behind rack rail holes.

h. Install two 10-32 X 3/8 binder head screws (6), first through front of rail, then through stationary section flange and secure loosely with a nut plate (7).

i. Mount mounting bracket to rear of rack by placing flange in front of rack rail holes.

j. Install two 10-32 X 3/8 binder head screws (8), first through back of rack, then through mounting bracket flange and secure loosely with a nut plate (9).

k. Check alignment and correct as necessary. Tighten front, rear, and mounting bracket attachment screws.

l. Repeat steps b through j for other side.

m. Install the bottom edge of the rack latch bracket (10) on the left rail 2.13 inches below the center-line of slide using two 6-32 X 7/16 flat head screws (11), flat washers (12), split-lock washers (13) and No. 6 hex nuts (14).

n. Slide intermediate sections forward until locks engage.

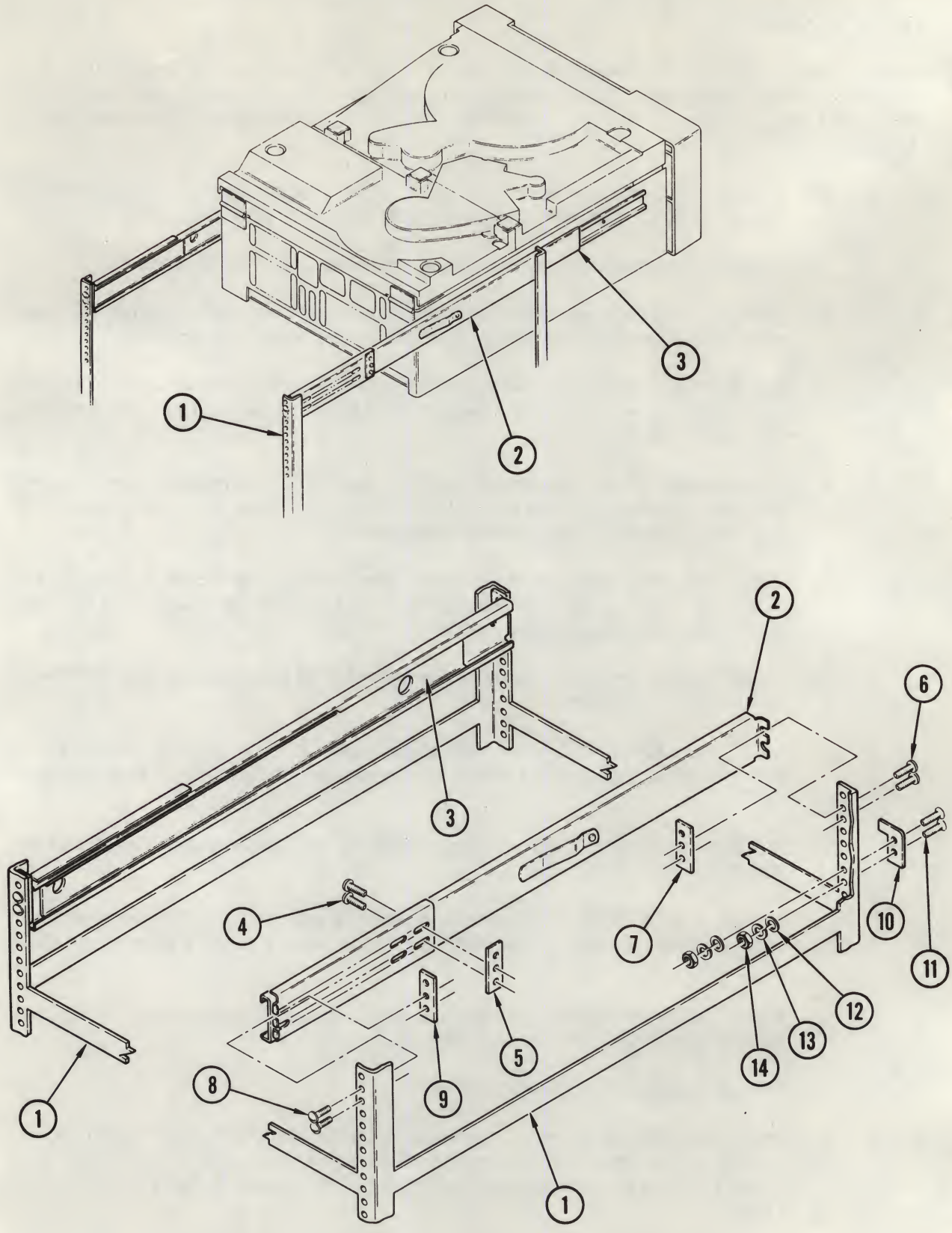

Figure 1-1. Rack Mounting

o. Carefully slide the MTSU's transport-attached chassis mount sections (15) into intermediate sections while checking for binding or interference. Release locks and, before closing fully, check that the rack latch will engage securely.

p. Adjust rack latch bracket (10) or slides as required. To release, squeeze rack latch plate inside air duct opening at lower left of front panel.

q. Connect the power cord. A service loop must be provided. Ensure the cord will not chafe or interfere with other equipment.

INTERFACE CONNECTIONS

1-7. It is recommended that interconnection of the MTSU and customer equipment be made with a flat ribbon cable or a harness of individual twisted pairs, each with the following characteristics:

a. Maximum length of 25 feet.

b. Not less than one twist per inch when using twisted pair.

c. 22- or 24-gauge conductor with minimum insulation thickness of 0.01 inch on twisted pair cables.

d. 28-gauge conductor is used with flat ribbon cable.

1-8. It is important that the ground side of each twisted pair, or the alternate conductor in a ribbon connector, be grounded. The mating connector (3M Company Part No. 3415-0001 or equivalent) must be wired by the customer. For twisted-pair cables, connector (Viking Part No. 3VT25/og JNH12 or equivalent) should be used.

1-9. Strain relief for flat-ribbon interface cables is provided for by the retainer included in the mounting hardware package. Install the connector retainer as follows:

a. Insert spring-loaded pins into holes located at each corner of PWB.

b. Lift retainer to allow access to edge connectors.

c. Install ribbon cables so that cables are on bottom sides of mating connectors.

d. Lower retainer and position over back sides of I/O connectors.

MULTIPLE-TRANSPORT OPERATION

1-10. The MTSU may be configured to allow operation of up to eight transports with a single controller. Use cables similar to those described in paragraph 1-7 for interconnection of transports. Refer to Figures 1-3 and 1-4.

1-11. To configure the MTSU to operate on a multiple transport system, proceed as follows:

a. Place MTSU in service access position. (See paragraph 4-4.)

b. Remove terminator resistor pack U3W and U10W (Figure 1-5) from each transport except last unit.

c. Install interconnection cables as shown in Figure 1-5.

1-12. The transport is selected by a combination of the levels on the IFAD, ITAD0, and ITAD 1 lines and the position of switches S1, S2, and S4. Refer to Table 1-2 for address decoding.

ADDRESS	IFAD	ITAD 0	ITAD 1	S1	S2	S4
0	0	0	0	1	1	1
1	0	0	1	1	1	0
2	0	1	0	1	0	1
3	0	1	1	1	0	0
4	1	0	0	0	1	1
5	1	0	1	0	1	0
6	1	1	0	0	0	1
7	1	1	1	0	0	0
	0 = False Interface Level 1 = True Interface Level			0 = Open 1 = Closed		

Table 1-2. Address Line Decoding

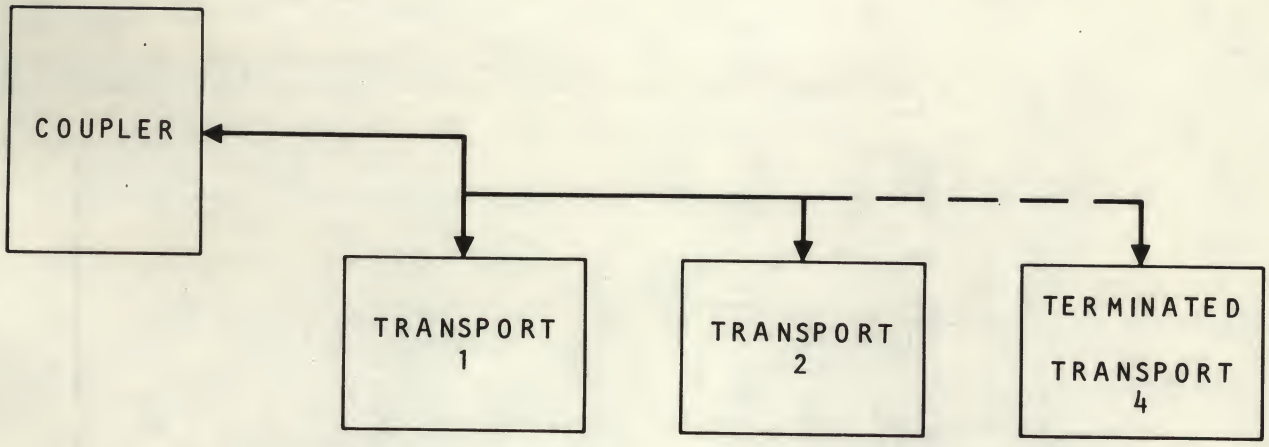

Figure 1-2. Daisy Chain Configuration

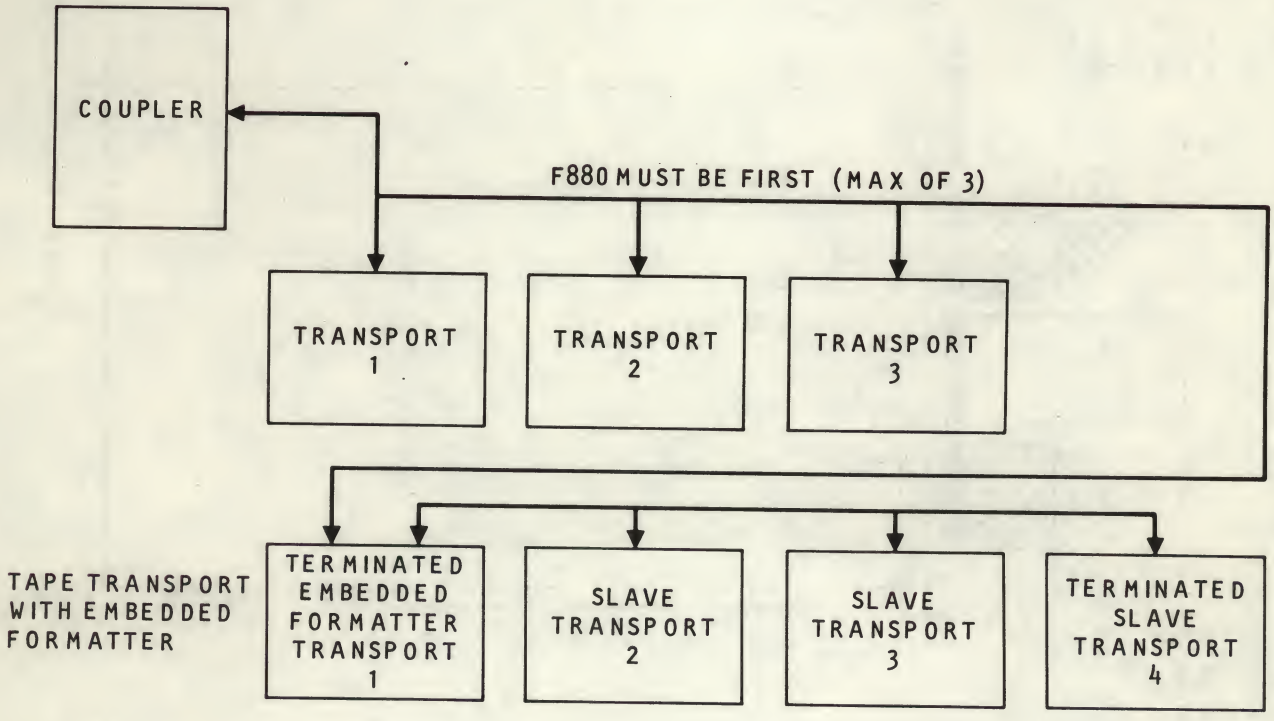

Figure 1-3. Daisy Chain with Embedded Formatted Drive

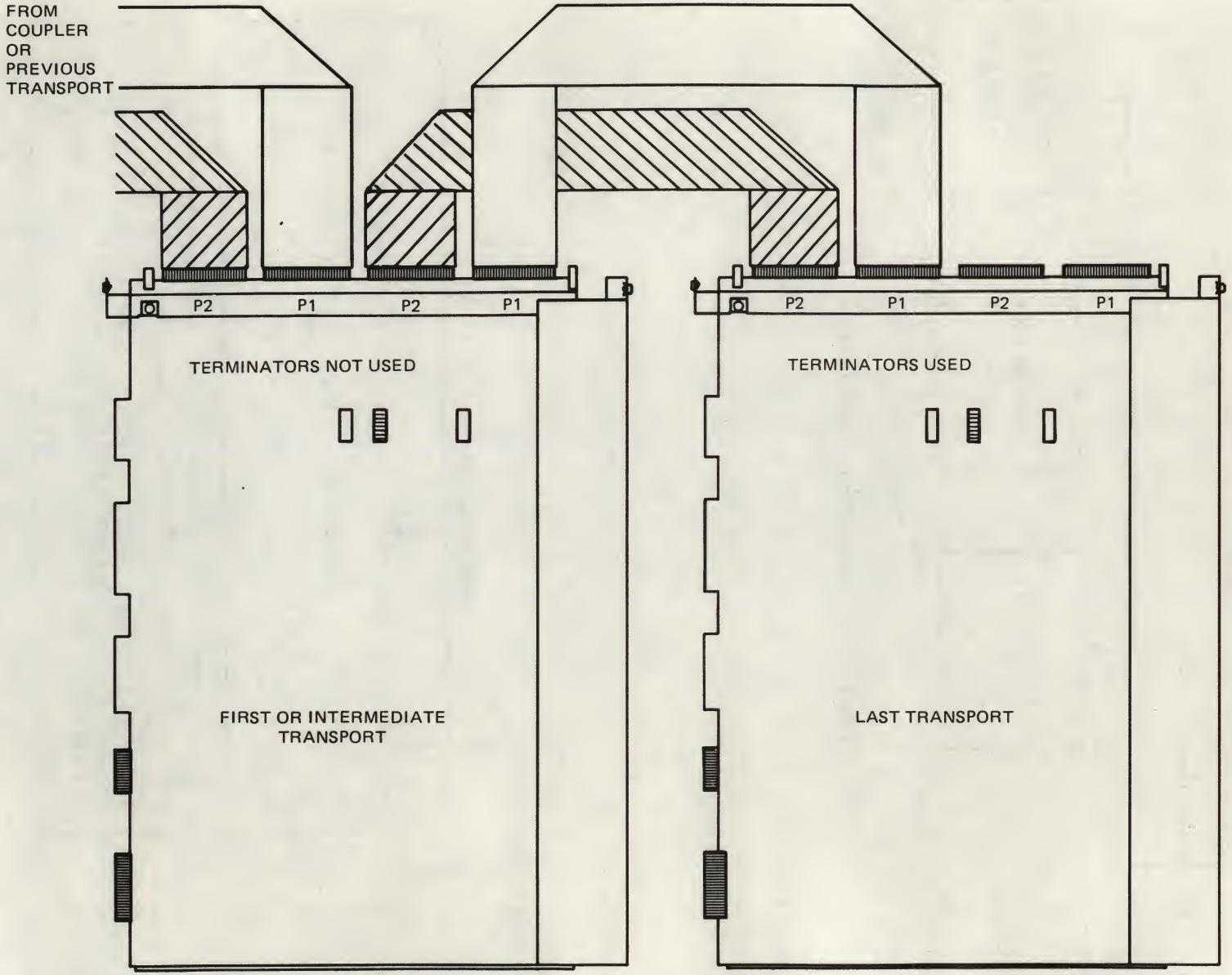

Figure 1-4. Daisy Chain Cable Configuration

SECTION II

OPERATION

GENERAL

2-1. This section describes the controls and indicators of the MTSU and provides operating instructions.

CONTROLS AND INDICATORS

2-2. Control/indicator types, functions, and the conditions required for enabling the corresponding functions are given in Table 2-1. Figure 2-1 shows the controls and indicators.

LOADING TAPE

2-3. To load tape, proceed as follows:

CAUTION

Do not attempt to open either top cover or front-panel door during load operation or while tape is loaded in transport. Both front-panel door and top cover are locked during tape-loaded functions.

a. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 2 seconds.)

b. Insure that tape is wound completely onto reel.

c. Open front-panel door by pressing down gently on top (center) of door.

d. Insert tape into front of unit with write-enable ring side down.

e. Close front-panel door.

f. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	ON/OFF Rocker Switch and Indicator	Switches line power on and off.	Fuse installed. Line cord connected.
LOAD REWIND	Tactile Switch and indicator	Loads tape to BOT marker. Rewinds tape to BOT marker. Illuminates to indicate BOT tab is positioned at photo-sensor. When pulsing, transport is executing a load or a rewind sequence.	Tape inserted in front panel door. Top cover and front panel door closed. Transport in off-line mode (ON-LINE indicator not illuminated).
UNLOAD	Tactile Switch and Indicator	Unloads tape from any point. UNLOAD indi-cator flashes during unload se-quence, then remains illuminated.	Transport in off-line mode. (ON-LINE indi-cator not illuminated.)
ON-LINE	Tactile Switch and Indicator	Switches transport to on-line mode. Illumi-nates to indicate transport is on line. Second actuation switches transport off line. Indicator extin-guished to indicate transport is off line.	During load sequence actuation of ON-LINE switch will place transport on line when BOT marker is sensed. Transport is in on-line mode. (ON-LINE in-dicator illuminated.)
TEST	Tactile Switch	Selects alternate operational mode for other switches.	Refer to paragraph 3-3.
WRT EN (Write Enable)	Indicator	Illuminates to indicate write function may be performed.	Tape reel write enable ring installed mounted on supply hub and tape loaded.
HI DEN (High Density)	Tactile Switch and Indicator	First actuation (indi-cator illuminated): high-density mode, 3200 bpi; second actuation (indicator extinguished): lower density , 1600 bpi.	3200 bpi transport must be in off-line mode (ON-LINE indi-cator extinguished.)

Table 2-1. Controls and Indicators

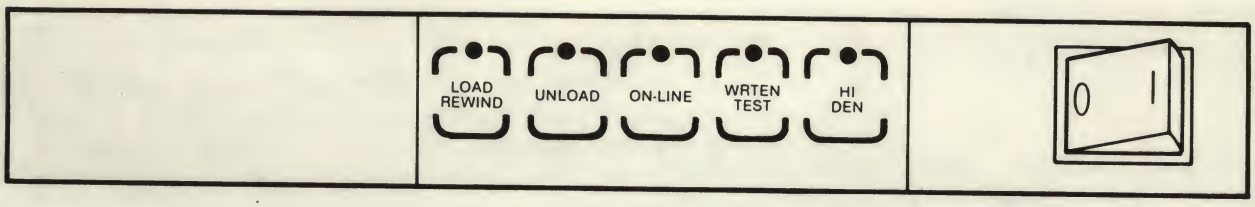

Figure 2-1. Control Panel

UNLOADING TAPE

NOTE

Transport must be in off-line mode (ON-LINE indicator extinguished).

2-4. To unload tape, proceed as follows:

a. Actuate UNLOAD switch.

NOTE

During the unload sequence, UNLOAD indicator will pulse and access doors will remain locked. When the unload sequence is completed, UNLOAD indicator will remain illuminated and access doors will unlock.

b. Open front-panel door when UNLOAD indicator remains illuminated.

c. Carefully remove tape reel.

d. Close front-panel door.

ERROR CONDITIONS

2-5. Operating failures or fault conditions are indicated by various front panel display patterns. There are two groups of error indications: those which are normally caused by the operator and can be avoided by following the proper operating procedure, and those which are machine malfunctions and require correction by an experienced service technician.

2-6. **Operator Error Codes.** These error indications are those which occur during normal tape loading operation and are usually caused by operator error. They produce error codes which will be displayed as an even, ON/OFF pattern of the indicators on the front panel. Refer to Table 2-2.

2-7. **Transport Error Codes.** These codes indicate a serious deviation from the normal operating routine of the MTSU. Each error code is represented as a unique binary pattern of the front panel indicators, which flash a quick double-pulse to alert the operator. Refer to Section III for troubleshooting instructions.

INDICATION	CONDITIONS
All indicators flashing	After four attempts, the MTSU did not successfully complete the load sequence. The tape leader should be checked for excessive damage. If a second attempt at autoloading fails, refer to paragraph 3-14 for manual load instructions.
All indicators except LOAD flashing	The BOT marker was not detected within the first 35 feet of tape. The leader must be a minimum of 6 feet in length.
All indicators except UNLOAD flashing	Tape reel was inserted upside-down. The bottom of the tape reel is indicated by the presence of an insertable write-enable ring near the inside mounting radius.
All indicators except ON-LINE flashing	A load or unload operation was attempted with the front-panel door or top cover in the open position.
All indicators except TEST flashing	A load operation was attempted without inserting a tape reel into the transport.

Table 2-2. Operator Error Front Panel Indications

MANUAL LOAD

2-8. To load tape after a failure of the autoloading routine proceed as follows:

a. Extend unit on its slides to clear equipment rack.

b. Place transport in operator maintenance access position by lifting top cover sides behind front panel. Place cover stay in slot provided.

c. Place reel of tape on supply hub. Ensure that reel is evenly seated on hub.

d. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simulataeously rotate the supply hub clockwise until supply reel is locked in place.

e. Thread tape along path shown in Figure 2-2. Carefully move tachometer assembly carefully away from takeup hub, and, making one wrap of tape clockwise around takeup hub, gently replace tachometer assembly. Check that tape is seated correctly on guides and threaded properly over head assembly.

f. Close top cover, and place transport in normal operating position.

g. Depress and hold the HI DEN switch, then actuate the LOAD switch and release both. Tape should tension and advance forward until BOT tab is positioned at photosensor. LOAD indicator will illuminate, indicating that MTSU is ready for use.

MANUAL UNLOAD

2-9. If for any reason the MTSU cannot complete the rewind/unload sequence, the tape reel may be rewound manually as follows:

a. Place transport in operator maintenance access position. Refer to paragraph 4-2.

b. Rotate supply reel in counterclockwise direction to rewind tape onto supply reel.

c. Depress manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply reel counterclockwise until it rotates freely and can be removed from the transport.

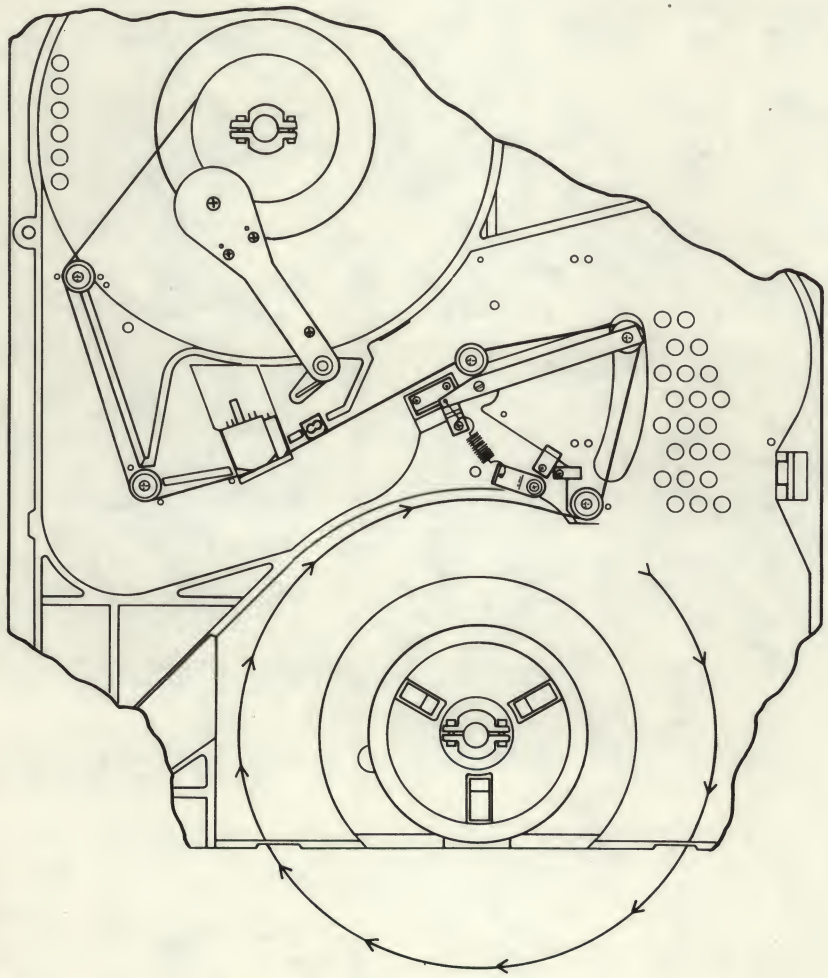

Figure 2-2. Tape Threading Path

SECTION III

TESTING AND TROUBLESHOOTING

TESTING

3-1. The MTSU incorporates three separate types of internal testing facilities. These self-test and diagnostic systems detect certain fault conditions and provide alignment and service aids for preventive maintenance.

3-2. **Self Test.** During power-up operation all indicator lights on the front panel are illuminated for approximately 1 second. If all indicators remain extinguished except UNLOAD following this period of time, no defect is indicated. If all indicators remain illuminated, then a failure of the ROM or RAM test is indicated. The auto-zero D to A, tachometer, and takeup servo circuits are also checked during the power-up diagnostic. Refer to paragraph 3-29 for a description of error indications.

3-3. **Diagnostic Mode Operation.** Diagnostic Service Aids are separated into two groups: those performed without tape loaded, and those performed with tape loaded on the transport. These service aids are designed to aid the technician in the isolation of electrical/electronic system failures and their remedies. Refer to paragraph 3-32 for troubleshooting instructions.

3-4. Referring to Figure 3-1, which illustrates the controls of the MTSU, the switch sequence for activating each service aid is as follows:

a. Actuate transport power switch to ON.

b. Press switches 4 and 5 in sequence.

c. Press switches corresponding to test number

d. Execute diagnostic by pressing switch 5.

e. Press switch 4 to exit diagnostic mode.

3-5. **Front Panel Indicators.** During operation in the diagnostic mode, the front panel indicators provide output data relative to the service aid being performed. This data is displayed as a binary pattern with the LOAD/REWIND indicator as the least significant bit (LSB) and the HI DEN indicator as the most significant bit (MSB). For example, during diagnostic Service Aid 14 with no tape loaded on the unit, the front panel indicators could display a binary count of 8 (TEST indicator flashing), which represents a nominal tachometer quadrature phase shift of 90 degrees. See Figure 3-1.

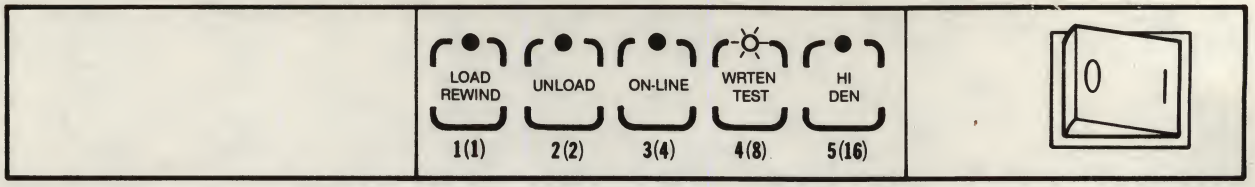

Figure 3-1. Front Panel Controls and Indicators (Diagnostic Mode)

NOTE

The complete switch sequence must be entered within 3 seconds, or the diagnostic routine will be aborted and the switch sequence will have to be reentered.

3-6. As an example, to cycle supply and takeup servos in the forward and reverse direction, Service Aid 11 would be used with no tape loaded on the unit. To access Service Aid 11 proceed as follows:

a. Actuate transport power switch to ON.

b. Press switches 4 and 5 in sequence.

c. Press switch 1 twice.

d. Execute Service Aid 11 by pressing switch 5.

3-7. **Diagnostic Mode (Tape Unloaded).** Diagnostic mode Service Aids with no tape in the transport are described in the following subparagraphs. Refer to paragraph 3-5 for description of front panel indicators.

3-8. Service Aid 11. This service aid enables both supply and takeup servo circuits, sequencing both reel hubs clockwise and counterclockwise. Press the LOAD switch to activate the high voltage rail drivers Q5 and Q6 (Sheet 4 of Dwg. No. 360103-309), and current limit the servos to 1 ampere. Press the UNLOAD switch to deactivate Q5 and Q6 and enable maximum current limit.

3-9. Service Aid 12. This service aid activates and deactivates the write circuitry to allow troubleshooting of the circuit with no tape loaded on the transport. To simulate a 100-ips data rate, press the LOAD switch. Actuation of the UNLOAD switch will select the 25-ips data rate. If the ILWD interface line is asserted, a 1-character pattern is written, including preamble and postamble.

3-10. Service Aid 13. This service aid performs the same functions as Service Aid 12, except the file-mark circuits are exercised.

3-11. Service Aid 14. Only the takeup servo is activated in this service aid. The purpose of this service aid is to sample the phase relationship for each quadrature of the tachometer assembly. During the first 5 seconds of the service aid, all indicators remain illuminated. Following this delay the percentage of phase shift between both tachometer inputs for quadrature 00 is displayed on the front panel indicators. Actuation of the LOAD switch will sequence to the next quadrature until all four of the phase quadratures have been displayed. On the next LOAD switch actuation, the

servo direction is reversed and the previous sequence repeated. See Figure 3-2. A display count of 8 represents the nominal phase shift of about 90 degrees. The minimum phase shift allowable is 30 degrees, or a binary count of 3.

3-12. Service Aid 21. In this service aid hardware ports ONL and RWD are toggled with interrupts disabled for repeatable triggering. The on-line status latch and rewind status latch are pulsed in sequence. Next, the read formatter enables and the six output status ports are toggled in binary sequence. After a 10-millisecond delay, the entire sequence is repeated. The lines are toggled in binary sequence to allow quick, shorted-line detection, and to provide easily recognizable patterns for troubleshooting.

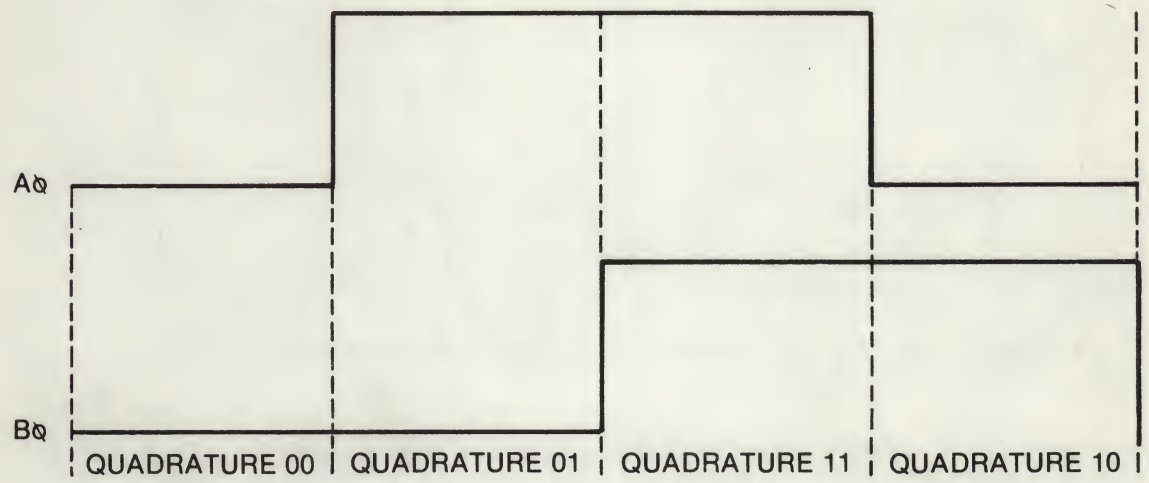

Figure 3-2. Tachometer Phase Quadrature

3-13. Service Aid 22. This service aid is used to display the output voltage of the BOT sensor via the front panel indicators. The value is periodically updated to allow insertion of a small piece of half-inch tape with a BOT reflective marker so that voltage levels produced from blank tape and BOT marker can be checked. To avoid erroneous indications, it may be necessary to shield the EOT/BOT sensor from ambient light. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.16) = Output Voltage

3-14. Service Aid 23. This service aid is identical to Service Aid 22, except that the EOT circuit is activated.

3-15. Service Aid 24. This service aid measures the tension arm transducer voltage and displays the value as two 4-bit nybbles. The low-order bits (0 - 3) are displayed when the HI DEN indicator is not illuminated, and the high-order bits (4 - 7) are displayed when the HI DEN indicator is illuminated. The normal indicated range should be between negative 0.46 volt and positive 4.10 volts. Actuation of the LOAD switch will sequence the display from the low-order bits to the high-order bits. Refer to Table 3-1. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.04) = Transducer Voltage

BITS	BITS	VOLTAGE
7 6 5 4	3 2 1 0	
0 1 1 1	1 1 1 1	+4.96
0 1 1 1	1 1 1 0	+4.92
0 1 1 1	1 1 0 1	+4.88
. . . .	. . . .	....
. . . .	. . . .	....
0 0 0 0	0 0 0 1	+0.04
0 0 0 0	0 0 0 0	0.00
1 1 1 1	1 1 1 1	-0.04
. . . .	. . . .	....
. . . .	. . . .	....
1 0 0 0	0 0 1 0	-4.92
1 0 0 0	0 0 0 1	-4.96
1 0 0 0	0 0 0 0	-5.00

Table 3-1. Compliance Arm Voltage Display

3-16. Service Aid 24 can also be used to display the absolute output of the compliance arm. To measure the voltage delta, actuate the UNLOAD switch while positioning the compliance arm against the forward stop. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.04) = Voltage Delta

3-17. Service Aid 31. Only the supply servo is enabled in this service aid. Its purpose is to check the file-protect/reel-seat sensor and the tape-in-path sensor. To check the file-protect sensor, remove the write-enable ring from a reel of tape and place the tape on the supply hub. As the supply hub slowly rotates in a counterclockwise direction, a quick double pulse of the UNLOAD indicator should occur, which can only be observed by grasping and slowly rotating the supply hub until the reel-seat reflector moves past the sensor. With the write-enable ring installed, a single pulse of the UNLOAD indicator should also be observed as the file-protect tab rotates past the sensor. The LOAD indicator should initially be illuminated, indicating no tape in path. To check the sensor, insert a piece of half-inch tape so that it blocks the tape-in-path sensor and extinguishes the LOAD indicator.

3-18. Service Aid 32. This service aid rotates the supply servo counterclockwise while activating the hub lock solenoid. The hub should come to a stop when the hub tab engages the bellcrank. The reel servo is momentarily reversed and the hub lock solenoid disengaged. The hub is then positioned past the solenoid latch before it is reactivated and the cycle repeated. During this service aid, the door interlocks are also cycled. If both top cover and front panel doors are not closed, the ON-LINE indicator will illuminate.

CAUTION

This service aid is intended for use by skilled technicians only. Repeated activation of this service aid could damage door interlocks.

3-19. Service Aid 33. This service aid disables both top-cover and front panel door interlocks to allow observation of the tape path during operation. Door interlocks are reactivated when tape is unloaded following completion a load sequence or when transport power is turned off.

3-20. Service Aid 34. During this service aid, the LOAD switch controls the blower motor. When the LOAD indicator is illuminated, the blower motor should be activated.

3-21. **Diagnostic Mode (Tape Loaded).** Diagnostic mode service aids with tape in the transport are described in the following subparagraphs.

3-22. Service Aid 11. This service aid injects a 0.2-volt (peak-to-peak) 500 kHz, triangle wave (RNOISE) into the read amplifier circuits. This service aid may also be activated by the controller. Select this service aid only during 1600 bpi operation. If this service aid is selected during 3200 bpi operation, Hard Errors will result.

3-23. Service Aid 12. This service aid disables Service Aid 11.

3-24. Service Aid 13. Approximately + 0.25-volt of ripple is injected into the +5 VCC circuits. This service aid provides additional margin checking when combined with Service Aid 11 and activated during systems diagnostic operation.

3-25. Service Aid 14. This service aid disables Service Aid 13.

NOTE

Both Service Aids 11 and 13 are deactivated during tape unload and whenever the power-up sequence is initiated. This prevents inadvertent use of either service aid during normal operation.

3-26. Service Aid 21. This service aid allows adjustment of the read threshold circuit by utilizing the LOAD and UNLOAD indicators. Refer to paragraph 4-16.

3-27. Service Aid 22. During this service aid, the drive cycles tape in both forward and reverse directions while alternating speed between 25 and 100 ips. The front panel displays the maximum tension arm motion sensed before an arm fault would occur.

3-28. Service Aid 23. This service aid can be used to write data blocks at either 25 ips (LOAD switch activated) or 100 ips (UNLOAD switch activated). Last word (ILWD) must be grounded to generate a one-character data block complete with postamble. If ILWD is not grounded, a HER and a CER status will occur. If the reel of tape loaded on the transport does not have a write enable ring installed, only the data previously written on the tape will be read. The 3200 bpi MTSU has the additional capability of writing and reading at 3200 bpi (50 ips) by pressing the LOAD or UNLOAD switch

following selection of Service Aid 23 with the transport operating in the HI DEN mode. Both models will perform a read reverse operation during Service Aid 23 if the HI DEN switch is depressed while selecting the desired operating speed.

NOTE

When operating the MTSU in a multiple transport (daisy chain) configuration it is recommended that the system software be halted during execution of the following Service Aids: Service Aid 12, 13, and 21 with no tape loaded; Service Aid 21 and 23 with tape loaded.

TRANSPORT ERROR CONDITIONS

3-29. Abnormal conditions are indicated by various front panel display patterns. These error codes are also displayed as binary-coded patterns.

3-30. **Transport Error Codes.** These codes indicate a serious deviation from the normal operating routine of the MTSU. Each error code is represented as a unique binary pattern of the front panel indicators which flash a quick double-pulse to alert the operator.

3-31. Table 3-2 identifies each error code and describes briefly the conditions which may have caused the failure. Before normal operation is attempted, transport power must be turned off to reset the error. If the error code is repeated, refer to paragraph 3-32 for troubleshooting instructions.

BINARY CODE	INDICATION	CONDITIONS
3	LOAD and UNLOAD indicators flashing	The MTSU detected more than 3700 feet of tape beyond the BOT marker.
4	ON-LINE indicator flashing	The tension arm swing exceeded the range of normal operation during the auto load sequence.
5	LOAD and ON-LINE indicators flashing	The MTSU received an interface command prior to completion of the previous command.
6	UNLOAD and ON-LINE indicators flashing	The MTSU received a write command with a write-protected reel of tape loaded on the transport.
7	LOAD, UNLOAD, and ON-LINE indicators flashing	An illegal or undefined command was received by the MTSU.
8	TEST indicator flashing	A failure of the supply hub locking mechanism occurred.
9	NOT USED	-
10	UNLOAD and TEST indicators flashing	The auto-zero function of the digital-to-analog converter failed during the power-up sequence.
12	ON-LINE and TEST indicators flashing	Supply reel was not seated on hub, or a failure of the file protect circuit occurred.
13	LOAD, ON-LINE, and TEST indicators flashing	Supply reel did not remain locked during tape unload operation.
14	TEST, UNLOAD, and ON-LINE indicators flashing	Because of a controller error, tape travel beyond the EOT marker exceeded 18 feet.
17	LOAD and HI DEN indicator flashing	The tape buffer tension arm exceeded its free travel limits during any operation except those functions of the load and unload sequence where tape tension is not under arm control.
18	UNLOAD and HI DEN indicator flashing	Tape speed variations in excess of the ANSI maximum of ±10% deviation from normal operation speed occurred.

Table 3-2. System Fault Codes

TROUBLESHOOTING

3-32. Before performing any troubleshooting operation, the technician must have a good understanding of the theory of operation of the transport and any associated equipment. He should check carefully to ensure that all equipment is connected properly and that all associated equipment is in good operating condition. He should be thoroughly familiar with operating instructions and follow them carefully in performing the troubleshooting procedure.

3-33. To enable the maintenance technician to isolate malfunctions within the Magnetic Tape Streamer Unit (MTSU), the Troubleshooting Test Procedures (TTP) contain a recommended sequence to troubleshoot each malfunction. Erroneous failure symptoms may be caused by failures in the microprocessor circuitry. If a definite failure is not established upon completion of a specific TTP, use the TTP power-up failure (PF1000) to troubleshoot the microprocessor circuitry. Tables 3-3, 3-4, 3-5, and 3-6 list common symptoms associated with operation of a MTSU together with the probable cause and remedial action required to correct each failure.

3-34. Table 3-3 contains malfunction symptoms the MTSU may exhibit following a power-up failure.

3-35. Table 3-4 contains the malfunction symptoms the MTSU may exhibit if a failure occurs in the auto load sequence. Each malfunction will produce a fault code which displays itself as a steady flashing pattern ("on" then "off") on the respective front-panel indicators.

3-36. Table 3-5 contains the malfunction symptoms the MTSU may exhibit if a serious deviation takes place from the normal operating routine within the MTSU. Each symptom will be shown as a unique binary pattern on the front-panel indicators.

3-37. Table 3-6 contains the malfunction symptoms the MTSU may exhibit if a failure occurs outside the internal diagnostic circuits of the MTSU and cannot be detected.

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Failure to complete power-up sequence. Transport unable to initiate any local or remote commands.	During power-up operation, all indicator lights on front panel illuminate for approximately one second. If all indicators extinguish except UNLOAD, no defect is indicated.	Refer to power-up failure TTP PF1000.
	Any invalid fault code also indicates failure. If the fan begins operating at power-up, a failure is also indicated.	Refer to TTP PF1000.

Table 3-3. Power-Up Malfunction Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
All indicators flashing	1. After four automatic retries, transport cannot successfully complete load sequence. 2. Tape leader may be excessively damaged.	Refer to TTP LD1000. Remove damaged tape leader and replace BOT.
All indicators except LOAD flashing	BOT marker was not detected within first 35 feet of tape.	Check tape for BOT marker. Use Service Aid 22 to check BOT sensor. Refer to TTP BE1000.
All indicators except UNLOAD flashing	1. Tape reel inserted upside-down. 2. Tape-in-path sensor failed.	Insert reel correctly. Use Service Aid 31 to check tape path sensor. Refer to TTP HS1000.
All indicators except ON-LINE flashing	Load operation attempted with front panel door or top cover in open position.	Use Service Aid 32 to check door lock. Refer to TTP HD1000.
All indicators except TEST flashing	Load operation attempted without reel of tape inserted in unit.	1. Open top cover; verify reel is seated on supply hub. If not, retry load operation. During load operation, verify supply servo rotates in counterclockwise direction. Use Service Aid 11 to check supply servo. Refer to TTP SE1000. 2. If reel is seated and supply hub is rotating counterclockwise, use Service Aid 31 to check reel seat sensor. Refer to TTP HS1000.

Table 3-4. Operator Error Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
LOAD and UNLOAD indicators flashing	MTSU detected more than 3700 feet of tape beyond BOT marker.	1. Usually caused by long reel of tape. Try different reel of tape. 2. Use Service Aid 14 to check tachometer position logic. Refer to TTP TA1000.
ON-LINE indicator flashing	Tension arm swing exceeded range of normal operation during load sequence.	1. Only occurs during load operation. Open top cover; verify tape is properly wrapped around takeup hub. If so, check compliance arm using Service Aid 24. Refer to TTP CA1000. 2. If tape is not wrapped around takeup hub, refer to TTP LD1000.
LOAD and ON-LINE indicators flashing	MTSU received interface command prior to completion of previous command. IGO should not go true until IDBSY goes false.	1. Usually caused by system failure. 2. Use Service Aid 21 to check interface signal IDBSY. Refer to TTP TI1000.
UNLOAD and ON-LINE indicators flashing	MTSU received write command with write-protected reel of tape loaded on MTSU.	1. Reset error code and reload tape. If WRT/EN indicator is extinguished, use Service Aid 31 to check file protect sensor. Refer to TTP HS1000. 2. If WRT/EN indicator is illuminated, use Service Aid 21 to check interface line to controller. Refer to TTP TI1000.

Table 3-5. Transport Failure Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
LOAD, UNLOAD, and ON-LINE indicators flashing.	Illegal or undefined command was received by MTSU.	1. Check cables and interface command lines to MTSU. 2. Refer to TTP CL1000.
TEST indicator flashing	Failure of supply hub lock mechanism occurred.	1. Failure only occurs during load sequence. If reel appeared to lock correctly, use Service Aid 11 to check D to A converter. Refer to TTP SE1000. 2. Use Service Aid 32 to check hub lock solenoid. Refer to TTP HD1000.
UNLOAD and TEST indicators flashing	Auto-zero function of D to A converter failure during power-up sequence.	To bypass this error, switch MTSU power ON while pressing the TEST switch. Select Service Aid 11 to check D to A converter. Refer to TTP SE1000.

Table 3-5. Transport Failure Symptoms (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
UNLOAD, ON-LINE, and TEST indicators flashing.	Because of controller error, tape travel beyond EOT marker exceeded 18 feet.	Use Service Aid 21 to check IEOT interface line. Refer to TTP T11000.
LOAD and HI DEN indicators flashing	The servo tension arm has exceeded its free travel limits during any operation except those functions of the load and unload sequence where tape tension is not under arm control.	1. If the MTSU missed the BOT or EOT marker and caused tape to run off reel, refer to TTP BE1000. 2. Use Service Aid 24 to check compliance arm. 3. Use Service Aid 11 to check servos and D to A converter. Refer to TTP SE1000.
UNLOAD and HI DEN indicators flashing	Tape speed variations occurred in excess of ANSI maximum of ±10% deviation from normal operating speed. Problem usually caused by bad tachometer assembly when drive is under system operation. A tachometer test is performed as part of the power-up diagnostic routine and may be bypassed to allow access to other diagnostic tests by depressing the TEST switch for 5 seconds during powerup.	1. If failure occurs during powerup, check that takeup hub moves momentarily counterclockwise then clockwise during powerup. If not, use Service Aid 11 to check the takeup servo. Refer to TTP SE1000. 2. Use Service Aid 14 to check tachometer. Refer to TTP TA1000.

Table 3-5. Transport Failure Symptoms (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Read or write errors during system operation	System is unable to complete data transfer.	1. To determine if errors are caused by read or write logic, try to read a known good tape. If errors still occur, troubleshoot read formatter. Refer to TTP RF1000. 2. If the tape is read successfully, problem is in write formatter circuitry. Use Service Aid 12 to check formatter. Refer to TTP WR1000.
Tape reel cannot be removed from transport	Tape not wound completely on supply reel or tape reel.	1. Following an unload operation, ensure that tape is wound completely on supply reel. Use Service Aid 22 to check EOT/BOT sensors. Refer to TTP BE1000. 2. If tape is completely wound on supply reel, the tape reel should be unlocked. Use Service Aid 32 to check hub lock. Refer to TTP HD1000. 3. Use Service Aid 11 to check takeup servo circuit. Refer to TTP SE1000.
MTSU "runs away" with Data Busy false	Transport formatter no longer controlling tape motion.	Use Service Aid 14 to check tachometer. Refer to TTP TA1000.

Table 3-6. System Failure Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Transport "runs away" with Data Busy true	Transport formatter no longer controlling tape motion.	1. First, check read threshold and verify that it is in proper operating range. If transport was executing read operation when runaway occurred, check read formatter. Use Service Aid 23 to check read formatter. Refer to TTP RF1000. 2. If transport was executing write operation, use Service Aid 12 to check write formatter. Refer to TTP WR1000.
Doors will not lock or unlock. Operator unable to insert tape into transport.	Door lock malfunctioning.	Use Service Aid 32 to check door lock. Refer to TTP HD1000.
When drive is placed ON-LINE, tape unloads.	Transport will not operate in on-line mode.	Disconnect cables between transport and computer. If a problem still exists, transport is at fault. Refer to TTP LD1000.
System detects one or more of the following interface signals are not valid: IFBY, IRDY, IDBSY, IFPT, ILDP, IEOT, IONL, IRWD, or ISPEED	System unable to verify correct transport status.	Refer to TTP TI1000 to check interface signals.
Transport ignores all commands sent by the controller, or transport executes a command other than the command issued by the controller.	System unable to initiate any remote command.	Check interface cable connection between drive and controller. Check command lines. Refer to TTP CL1000.
System is unable to select transport.	Invalid status indications from transport to controller.	Check interface cable connection to transport. Refer to drive selection TTP DS1000.

Table 3-6. System Failure Symptoms (Continued)

3-38. **Power Control and System Failure Detect TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the power control and system failure detect logic circuits.

STATEMENT NUMBER	
PF1000	During power-up operation all indicator lights on the front panel are illuminated for approximately one second. If all indicators remain extinguished except UNLOAD following this period of time, no defect is indicated. A failure to properly complete the power-up sequence will be indicated by one of the following error indications: a. If all front panel indicators remain illuminated following actuation of the POWER switch, refer to TTP PF1010. b. Following actuation of the POWER switch, if all indicators are illuminated for approximately one second, then briefly extinguished, then illuminated continuously, refer to TTP PF1130. c. If any invalid fault code is displayed by the front panel indicators during power-up operation, refer to TTP PF1010.
PF1010	Is the signal at TP 89 a +5.0 ±0.25Vdc level? YES = PF1020 NO = PF1030
PF1020	Is the signal at TP 63 at a +5.0 ±0.25Vdc level? YES = PF1080 NO = PF1060
PF1030	Is P3-6 at a +10.0 ±2.0Vdc level? YES = PF1040 NO = PF1050
PF1040	Problem is Q7. When replaced and the signal at TP 89 is at +5.0Vdc level, refer to TTP PF1000.
PF1050	Problem is on the power supply board or a bad cable connection. When repaired, refer to TTP PF1000.
PF1060	Is P3 pin 4 at a +24.0 ±5Vdc level? YES = PF1070 NO = PF1050
PF1070	Problem is Q20. When replaced and the signal at TP 63 is at +5.0 ±0.25Vdc level, refer to TTP PF1000.
PF1080	Is U3L-9 high? YES = PF1090 NO = PF1100

STATEMENT NUMBER	
PF1090	Problem is U1K or supporting components. When repaired, refer to TTP PF1000.
PF1100	Switch MTSU power off. Using a jumper, ground U3L-8. Also remove U10L from its socket. Switch MTSU power on. Does the system fail indicator (DS1) remain illuminated? YES = PF1110 NO = PF1120
PF1110	Problem is U1K, U3L, Q17, or K1. Remove ground wire and reinstall U10L. If MTSU still does not power up successfully, refer to TTP PF1100.
PF1120	Problem is U2K, U1H, or U10L. Remove ground wire and reinstall U10L. When repaired, refer to TTP PF1130.
PF1130	The following steps are used to troubleshoot the system clock. Is U6L-6 a 2.0 ±0.01MHz clock? YES = PF1170 NO = PF1140
PF1140	Is the signal at TP 62 an 8.0 ±0.01 MHz clock? YES = PF1160 NO = PF1150
PF1150	Problem is Y1, U8R, U8P, or supporting components. When repaired and the signal at TP 62 is an 8MHz clock, refer to TTP PF1000.
PF1160	Problem is U8P or U8R. When repaired, refer to TTP PF1000.
PF1170	The following steps will verify all necessary voltages are applied to the board. Is the signal at TP 92 at a +12 ±0.6Vdc level? YES = PF1190 NO = PF1180
PF1180	Problem is VR2. When repaired and the signal at TP 92 is at a +12.0Vdc level, refer to TTP PF1000.
PF1190	Is the signal at TP 63 at a +5.0 ±0.25Vdc level? YES = PF1210 NO = PF1200
PF1200	Problem is Q20. When repaired and the signal at TP 63 is correct, refer to TTP PF1000.
PF1210	Is the signal at TP 90 at a -12 ±0.6Vdc level? YES = PF1230 NO = PF1220

STATEMENT NUMBER	
PF1220	Problem is VR1, cable connection or power supply. When repaired, refer to TTP PF1000.
PF1230	Is U3B-7 at a -5.0 ±0.25Vdc level? YES = PF1250 NO = PF1240
PF1240	Problem is C162, C4, or R352. When repaired, refer to TTP PF1000.
PF1250	Is the signal at TP 89 at a +5.0 ±0.25Vdc level? YES = PF1265 NO = PF1260
PF1260	Problem is Q7, the cable connection, or with the power supply board. When repaired, refer to TTP PF1000.
PF1265	Switch MTSU power off. Using a jumper wire, ground pins 1 and 4 of U17N. Does the drive now power up correctly? YES = PF1266 NO = Remove ground wire. Refer to TTP PF1270
PF1266	The microprocessor is failing due to excessive interrupts from the tachometer circuitry. Go to TA1000 and troubleshoot the tachometer, keeping in mind that U17N pins 1 and 4 are grounded.
PF1270	The power-up failure has now been narrowed down to the microprocesor logic. Due to the complexity in troubleshooting this area, first replace the following socketed IC's one at a time. Switch MTSU power off when replacing an IC. U6P, U7P, U6N, U8N, U10N, U12N, U6L, U14N, U8L, U10L, U12L, and U14L. If failure still exists, go to PF1280.
PF1280	Replace the following: U8R, U9P, U10P, U7H, U5F, U3N, U3L, or U4R. If failure is still present, we are unable to determine the cause.

3-39. **Auto-Load Sequence TTP.** This TTP describes the diagnostic steps required to isolate a failure during the auto-load sequence (Service Aid 33).

STATEMENT NUMBER	
LD1000	Activate Service Aid 33 to allow observation of the tape path area and initiate the load sequence by pressing the LOAD switch. Does the supply hub slowly rotate counterclockwise? YES = LD1010 NO = SE1000
LD1010	Is the supply reel seated properly on the supply hub? If it is not, all indicators will flash except the TEST indicator. YES = LD1020 NO = HS1000
LD1020	Does the blower motor begin operation? YES = LD1030 NO = BL1000
LD1030	Does the MTSU lock the reel onto the supply hub? YES = LD1040 NO = HD1000
LD1040	Does the supply servo perform a high speed spin for a short time to determine reel size? YES = LD1050 NO = SE1000
LD1050	The supply servo should slowly turn counterclockwise until the end of tape is stripped off the reel and breaks the path of the tape-in-path sensor. The supply servo continues to turn counterclockwise until the tape is withdrawn and reenters a second time from the tape path, then the supply servo starts rotating in the clockwise direction, feeding tape in the column. Does this happen? YES = LD1060 NO = SE1000 or HS1000.
LD1060	Does the tape continue past the EOT/BOT sensors and toward the takeup hub? If the EOT/BOT sensors fail to detect the tape go by within three seconds from the time TIP sensor was tripped, the MTSU will rewind the tape back on the supply hub and automatically retry the load sequence. YES = BE1000 NO = LD1065
LD1065	Is the takeup servo rotating in the clockwise direction? YES = LD1070 NO = SE1000

STATEMENT NUMBER	
LD1070	The tachometer should sense a decrease in speed as the tape wraps around the takeup hub. Once the tape is wrapped securely around the takeup hub both the takeup and supply servos should come to a stop. Do they? YES = LD1090 NO = LD1080
LD1080	Observing the takeup servo, which of the following best describes the failure symptom? a. Tape wraps around the takeup reel but the servo doesn't try to come to a stop and after four or five seconds the tape is rewound on the supply reel. If so, first clean the takeup hub and verify the tape isn't slipping on the hub. If the problem still occurs refer to TTP TA1000. b. The takeup servo is very unstable; possibly even changing directions and a fault code 4 or 18 occurs. Refer to TTP TA1000. c. The takeup hub starts turning in the counterclockwise direction and the MTSU displays fault code 4. Refer to TTP SE1000.
LD1090	Next the MTSU will calibrate the compliance arm. If an error is found the MTSU will display fault code 4. Does the MTSU calibrate the arm successfully? YES = LD1100 NO = CA1000
LD1100	The MTSU should move tape forward at 25 ips while looking for the BOT marker and determine if the tape reel has a write-eanable ring. If the write-enable ring is present the WRTEN/TEST indicator should illuminate. Does it? YES = LD1110 NO = HS1000
LD1110	Does the tape stop with the LOAD indicator illuminated at the BOT marker? YES = LD1120 NO = BE1000
LD1120	Press the ON-LINE switch. Does the ON-LINE indicator illuminate? YES = LD1130 NO = LD1140
LD1130	The LOAD sequence is now complete and the MTSU is ready for system operation.
LD1140	Is the MTSU still at BOT? YES = LD1150 NO = LD1160

STATEMENT NUMBER	
LD1150	Problem is U17L, U10L, the switch panel or a bad cable connection between the switch and the formatter PWB. When repaired, refer to TTP LD1000.
LD1160	Is U3V-1 low? YES = LD1180 NO = LD1170
LD1170	Troubleshoot the IONL and IRWD interface lines using Service Aid 21. Refer to TTP TI1000.
LD1180	Is the interface signal IRWU at U4W-9 low? YES = LD1190 NO = LD1200
LD1190	Problem is U4W, U10W, or the controller is holding the interface line low. When repaired, refer to TTP LD1000.
LD1200	Problem is U4W, U4V, U5V, or U3V. When repaired, refer to TTP LD1000.

3-40. **Takeup and Supply Servo TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the takeup and supply servo circuits (Service Aid 11).

STATEMENT NUMBER	
SE1000	Select Service Aid 11 and visually inspect the drive. Which of the following best describes the observed malfunction, if any? a. Neither one of the servos is working correctly. Refer to TTP SE1010. b. Takeup servo is working; however, the supply servo is not. Refer to TTP SE1290. c. Supply servo is working; however, the takeup servo is not. Refer to TTP SE1130. d. Both servos appear to be working properly. Refer to TTP SE1460. e. If directed to check out the D to A from another section, refer to TTP SE1010.
SE1010	The following will check out the D to A circuitry. Is the signal VOUTØ (U3M-8) at a +0.75 ±0.2Vdc level? YES = SE1020 NO = SE1080

STATEMENT NUMBER	
SE1020	Is the signal VOUT1 (U3M-1) at a -0.7 ±0.1Vdc level? YES = SE1030 NO = SE1080
SE1030	Is the signal VOUT2 (U3M-14) switching between +2.0Vdc and -2.0Vdc ±0.2Vdc? YES = SE1040 NO = SE1080
SE1040	Is the signal VOUT3 (U3M-7) at a +0.5 ±0.1Vdc level? YES = SE1050 NO = SE1080
SE1050	Is the signal VOUT4 (U2M-7) switching between +2.0Vdc and -2.0Vdc ±0.2Vdc? YES = SE1060 NO = SE1080
SE1060	Is the signal VOUT5 (U2M-1) at a +0.5 ±0.1Vdc level? YES = SE1062 NO = SE1080
SE1062	Switch MTSU power off. Check U5E-4 during the power-up sequence while all front-panel indicators are illuminated. Does U5E-4 go to a +5.3 ±0.3Vdc level? YES = SE1066 NO = SE1064
SE1064	Problem is U5E or U2N. When repaired, refer to TTP SE1000.
SE1066	During the power-up sequence and while all front panel indicators are off, U5E-4 should go to ground, leveling off somewhere between +5.0Vdc and -5.0Vdc, then the UNLOAD indicator should illuminate. Which of the following best describes the signal on U5E-4: a. The signal stays at +5.3 ±0.3Vdc and the MTSU fails with fault code 10. Refer to TTP SE1064. b. The signal goes to zero volts ±0.5Vdc and the MTSU fails with fault code 10. Refer to TTP SE1068. c. The signal goes to zero volts, slowly moves to either +5.0Vdc or -5.0Vdc, then goes to +5.0 ±0.3Vdc and the drive fails with fault code 10. Refer to TTP SE1068. d. The drive powers up correctly as described. Refer to TTP SE1070.

STATEMENT NUMBER	
SE1068	Perform the test starting at SE1460. If, after replacing the IC's called out in statement number SE1780, the drive still fails with fault code 10, replace U5E and U2N. If a problem is found before reaching TTP SE1780, follow the instructions described in the statement.
SE1070	Reselect Service Aid 11. Do both servos appear to be operating correctly? YES = SE1460 NO = SE1130
SE1080	Is the signal at TP 60 toggling? YES = SE1090 NO = SE1100
SE1090	Replace U2N, U2M, U3N, and U3M. If the signal is still bad, problem is the destination IC. If troubleshooting VOUT1, replace U5E. If troubleshooting VOUT2, replace U4B. If troubleshooting VOUT3, replace U3D. If troubleshooting VOUT4, replace U3B. If troubleshooting VOUT5, replace U3A. When repaired, refer to TTP SE1000.
SE1100	Are the signals IOREQ* (U3L-3) and WR*(U4P-10) toggling? YES = SE1110 NO = SE1120
SE1110	Problem is U3L, U4N, U4P, or U4R. When repaired and the signal at TP 60 is toggling, refer to TTP SE1000.
SE1120	Problem is the Z80 microprocessor, U6L, or the test wasn't selected correctly. When resolved, refer to TTP SE1000.
SE1130	The following will check out the takeup servo circuitry. Is the signal at TP 14 switching between +10Vdc and -10 ±2Vdc? YES = SE1140 NO = SE1145
SE1140	Problem is a bad cable connection or a bad takeup motor. When problem is repaired and takeup servo is working correctly, refer to TTP SE1000.
SE1145	Check signals VOUT4 and VOUT5 by performing TTP SE1050 and SE1060. If the answer to both steps is YES, refer to TTP SE1150. If the answer to either one of the steps is NO, refer to the TTP it describes.

STATEMENT NUMBER	
SE1150	Is the signal P2A3 (U3B-11) low? YES = SE1170 NO = SE1160
SE1160	Problem is U12L. When repaired, refer to TTP SE1000.
SE1170	Is the signal at TP 61 at a -35.0 ±6.0Vdc level? YES = SE1220 NO = SE1180
SE1180	Is P3 pin 8 at a -35.0 ±6.0Vdc level? YES = SE1200 NO = SE1190
SE1190	Problem is the cable connection to the power supply or a failure in the power supply. When repaired and P3 pin 8 is at -35.0 ±6.0Vdc, refer to TTP SE1000.
SE1200	Is the signal P2B3 (U12L-30) low? YES = SE1210 NO = SE1160
SE1210	Problem is Q21, Q22, or Q5. When repaired and TP 61 is correct, refer to TTP SE1000.
SE1220	Is the signal at TP 6 switching between +9.0Vdc and -9.0 ±2.0Vdc? YES = SE1230 NO = SE1240
SE1230	Problem is U3B or one of the following transistors Q1, Q2, Q8, Q9, Q10, or Q11. When repaired, refer to TTP SE1000.
SE1240	Is the signal at TP 22 at a -0.5Vdc level? YES = SE1260 NO = SE1250
SE1250	Problem is U3A, R21, R20, CR1, or CR2. When repaired and the signal at TP 22 is at a -0.5Vdc level, refer to TTP SE1000.
SE1260	Does TP 16 go to a +10.0 ±2Vdc level for 80 ±40 milliseconds when the takeup hub starts to rotate clockwise and a -10.0 ±2Vdc level for 80 ±40 milliseconds when the servo starts to rotate counterclockwise? YES = SE1270 NO = SE1280
SE1270	Problem is U3A, R18, or R19. When repaired and TP 6 is correct, refer to TTP SE1000.

STATEMENT NUMBER	
SE1280	Problem is U3A, U3B, or supporting components. When repaired, refer to TTP SE1000.
SE1290	The following will check out the supply servo circuitry. Is the signal at TP 13 switching between +10.0Vdc and -10.0 ±2.0Vdc? YES = SE1300 NO = SE1310
SE1300	Problem is a bad cable connection to the servo circuit or a bad supply servo. When problem is repaired and supply servo is working correctly, refer to TTP SE1000.
SE1310	Check signals VOUT2 and VOUT3 by performing TTP SE1030 and SE1040. If the answer to both steps is YES, refer to TTP SE1320. If the answer to either one of the steps is NO refer to the TTP it describes.
SE1320	Is the signal P2A3 (U3B-10) low? YES = SE1330 NO = SE1160
SE1330	Is TP Ø at a +35.0 ±6Vdc level? YES = SE1380 NO = SE1340
SE1340	Is P3 pin 10 at a +35.0 ±6Vdc level? YES = SE1360 NO = SE1350
SE1350	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 10 is at +35.0 ±6Vdc, refer to TTP SE1000.
SE1360	Is the signal P2B2 (U12L-29) high? YES = SE1370 NO = SE1160
SE1370	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1000.
SE1380	Is the signal at TP 12 switching between +9.0Vdc and -9.0 ±2.0Vdc? YES = SE1390 NO = SE1400
SE1390	Problem is U3B or one of the following transistors: Q3, Q4, Q12, Q13, Q14, or Q15. When repaired, refer to TTP SE1000.
SE1400	Is the signal at TP 24 at a -0.5 ±0.2Vdc level? YES = SE1420 NO = SE1410

STATEMENT NUMBER	
SE1410	Problem is U3D, R71, R72, CR5, or CR6. When repaired and TP 24 is at a -0.5Vdc level, refer to TTP SE1000.
SE1420	Does TP 25 go to a +10.0 ±2.0Vdc level for 80 ±40 milliseconds when the takeup starts to rotate in the clockwise direction and a -10.0 ±2.0Vdc level for 80 ±40 milliseconds when the servo starts to rotate in the counterclockwise direction? YES = SE1430 NO = SE1440
SE1430	Problem is with U3A, R47, or R48. When repaired and TP 12 is correct, refer to TTP SE1000.
SE1440	Are signals P2A4 (U4B-11) and P2A5 (U4B-10) both high? YES = SE1450 NO = SE1460
SE1450	Problem is U4B or U3D. When repaired and TP 25 is correct, refer to TTP SE1000.
SE1460	The following will check out the inputs to the A to D converter. Is U2R-12 at a -3.0 ±0.5Vdc when the servos are rotating clockwise and at a +3.0 ±1.0 Vdc level when rotating counterclockwise? YES = SE1480 NO = SE1470
SE1470	Problem is U3E or U3D. When repaired and U2R-12 is correct, refer to TTP SE1480.
SE1480	Is U2R-1 at a -2.0 ±0.2Vdc level when the servos are rotating clockwise and at a +2.0 ±0.2Vdc level when rotating counterclockwise? YES = SE1500 NO = SE1490
SE1490	Problem is U3E or U3D. When repaired and U2R-1 is correct, refer to TTP SE1500.
SE1500	Is U2R-5 going to a -1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servos start to rotate in the clockwise direction and at a +1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servo starts to rotate counterclockwise? YES = SE1520 NO = SE1510
SE1510	Problem is R337, or C171; When repaired, refer to TTP SE1520.

STATEMENT NUMBER	
SE1520	Is U2R-2 going to a +1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servos start to rotate in the clockwise direction and at a -1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servo starts to rotate counterclockwise? YES = SE1540 NO = SE1530
SE1530	Problem is U3E or U3D. When repaired and U2R-2 is correct, refer to TTP SE1540.
SE1540	Is U2R-4 at a +2.5 ±0.5Vdc level when the servos are rotating clockwise and at a -2.0 ±0.5Vdc level when rotating counterclockwise? YES = SE1560 NO = SE1550
SE1550	Problem is U3B, R341, or C165. When repaired and U2R-4 is correct, refer to TTP SE1560.
SE1560	Is the signal at TP 61 a -35 ±6.0Vdc level? YES = SE1620 NO = SE1570
SE1570	Is P3 pin 8 at a -35 ±6.0Vdc level? YES = SE1590 NO = SE1580
SE1580	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 8 is at a -35.0 ±6.0Vdc level, refer to TTP SE1000.
SE1590	Is the signal P2B3 (U12L-30) low? YES = SE1610 NO = SE1600
SE1600	Problem is U12L. When repaired, refer to TTP SE1000.
SE1610	Problem is Q21, Q22, or Q5. When repaired and TP 61 is correct, refer to TTP SE1000.
SE1620	Is the signal at TP Ø a +35.0 ±6.0Vdc level? YES = SE1670 NO = SE1630
SE1630	Is P3 pin 10 at a -35.0 ±6.0Vdc level? YES = SE1650 NO = SE1640
SE1640	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 10 is at a +35.0 ±6.0Vdc level, refer to TTP SE1000.

STATEMENT NUMBER	
SE1650	Is the signal P2B2 (U12L-29) high? YES = SE1660 NO = SE1600
SE1660	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1000.
SE1670	Press the UNLOAD switch once. Is the signal at TP 61 -24.0 ±5.0Vdc? YES = SE1700 NO = SE1680
SE1680	Is the signal P2B3 (U12L-30) high? YES = SE1690 NO = SE1600
SE1690	Problem is Q21, Q22, or Q5. When repaired and the signal at TP 61 is -24.0 ±5.0Vdc, refer to TTP SE1700.
SE1700	Is the signal at TP Ø 24.0Vdc ±5.0Vdc? YES = SE1720 NO = SE1710
SE1710	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1720.
SE1720	Does the signal on TP 60 go low for 4.0 ±0.2 microseconds? YES = SE1770 NO = SE1730
SE1730	Does the signal on U4N-5 go high for 5.8 ±0.3 microseconds? YES = SE1740 NO = SE1760
SE1740	Does the signal on U4N-4 go low for 2.0 ±1.0 microseconds? YES = SE1750 NO = SE1760
SE1750	Problem is U4P or U4R. When repaired and TP 60 is correct, refer to TTP SE1000.
SE1760	Problem is U4N, U4P, or U3L. When repaired, refer to TTP SE1720.
SE1770	Does the signal at U4P-11 toggle? YES = SE1780 NO = SE1790
SE1780	Replace U2M and U2R. If problem still exists, we are unable to determine the cause of the failure.
SE1790	Problem is U4P, U3J, or U3L. When repaired, refer to TTP SE1000.

3-41. **Write Formatter TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the write formatter circuitry.

STATEMENT NUMBER	
WR1000	Activate Service Aid 12 with tape unloaded. This Service Aid activates the write formatter for approximately 3 milliseconds then resets the write circuitry for approximately 1 millisecond, then repeats the sequence. When the write circuit is active, check all nine data channels to the read/write head. Verify the following locations have a 3-microsecond square-wave clock: U17J-10, U18J-10, U17J-4, U18J-4, U17J-2, U18J-12, U17J-12, U18J-2, U17J-8, U18J-8, U17J-6, U18J-6, U18K-12, U18K-2, U18K-4, U18K-6, U18K-8, and U18K-10. Which of the following best describes the failures, if any? 1. All channels are working correctly. Refer to WR1010. 2. One or more channels are dead. Refer to TTP WR1120. 3. The channels are working but are the wrong frequency. Refer to TTP WR1240.
WR1010	Press the UNLOAD switch once. Is the signal W2XCLK* (U9R-8) an 80 ±0.08kHz clock? YES = WR1020 NO = WR1060
WR1020	Is the signal WHEADCT, P6 pin 1 at +11.0 ±0.5Vdc level for +3.0 ±0.5 milliseconds? YES = WR1030 NO = WR1090
WR1030	Is the signal at U4R-1 toggling? YES = WR1040 NO = WR1310
WR1040	Does the signal at U12P-7 go high for 950.0 ±50.0 microseconds? YES = WR1050 NO = WR1280
WR1050	All signals are correct leaving the board. Check cable connections and clean read/write head. If necessary, change head assembly. If problem still exists, we are unable to identify cause of the failure.
WR1060	Is the signal POB5 (U10R-3) high? YES = WR1070 NO = WR1080
WR1070	Problem is U10R, U11R, or U14W. When repaired and U9R-8 is an 80 kHz clock, refer to TTP WR1000.

STATEMENT NUMBER	
WR1080	Problem is U8L or the UNLOAD switch wasn't pressed. When repaired and U9R-8 is an 80kHz clock, refer to TTP WR1000.
WR1090	Is the signal P0B4 (U10H-1) a clock that is low for 3.0 ±0.5 milliseconds then goes high for 2.0 ±0.5 milliseconds? YES = WR1100 NO = WR1110
WR1100	The problem is U10H, Q36, Q37, Q38, head assembly, or a bad cable connection between the PWB and the head assembly. When repaired, refer to TTP WR1000.
WR1110	Problem is U8L. When repaired, refer to TTP WR1000.
WR1120	Are the signals P2B6 (U4P-1) and P2B7 (U4V-5) both clocks that are low for 2.0 ±0.5 milliseconds then high for 3.0 ±0.5 milliseconds? YES = WR1140 NO = WR1130
WR1130	Problem is U12L or the service aid wasn't selected correctly. When repaired, refer to TTP WR1000.
WR1140	Is the signal W2XCLK* (U18L-9) a 320 ±2.0 kHz clock? YES = WR1160 NO = WR1150
WR1150	Problem is U9R, U10R, U11R, or U10P. When repaired and U18L-9 is a 320 kHz clock, refer to TTP WR1000.
WR1160	During the 3 milliseconds that the write circuitry is active, are the signals FRC1 (U15W-10), FRC2 (U15W-2), and FRC3 (U15W-12) a 3.0 ±0.5 microsecond square-wave clock? YES = WR1170 NO = WR1180
WR1170	Depending on which channel is failing (determined in TTP WR1000) check the input of the failing channel's output inverter for a 3.0 ±0.5 microsecond square-wave clock. If the signal is correct, the problem is the output inverter, cable connection, or head assembly. If signal is incorrect, problem is U17K, U18L, U14W, U15W, or U13W. When repaired, refer to TTP WR1000.
WR1180	Is the signal LASTW* (U14R-2) low? YES = WR1185 NO = WR1200
WR1185	Is the signal W2XCLK* (U12W-9) toggling? YES = WR1190 NO = WR1250

STATEMENT NUMBER	
WR1190	Problem is U12W, U14R, or the interface line P1 pin 4 is shorted to ground. When repaired, refer to TTP WR1000.
WR1200	Is the signal at U14W-2 a 3.0 ±0.5 microsecond square-wave clock? YES = WR1210 NO = WR1230
WR1210	Is the signal at U14W-1 a 3.0 ±0.5 microsecond square-wave clock for 250 ±50 microseconds while remaining high the rest of the time? YES = WR1220 NO = WR1280
WR1220	Problem is U14W, U4P, U4V, or one of the destination IC's U13W, U14W, or U15W affecting the signal. When repaired, refer to TTP WR1000.
WR1230	Problem is U12R, U14R, U14W, or U8L. When repaired, refer to TTP WR1000.
WR1240	Is the signal W2XCLK* (U9R-8) a 320.0 ±2.0kHz clock? YES = WR1160 NO = WR1250
WR1250	Is the signal at U10R-2 an 8.0 ±0.008MHz clock? YES = WR1270 NO = WR1260
WR1260	Problem is with the clock generation circuit U8R or Y1. When repaired, refer to TTP WR1000.
WR1270	Problem is U10R, U11R, U9R, or U10P. When W2XCLK* is correct, refer to TTP WR1000.
WR1280	Is the signal P0B7 (U10P-4) always high? YES = WR1290 NO = WR1300
WR1290	Problem is U14R, U10P, U11P, U12P, or U14W. When repaired, refer to TTP WR1000.
WR1300	Problem is U10P or U8L. When repaired, refer to TTP WR1000.
WR1310	Problem is U14R, U4V, U4R, or U3J. When repaired, refer to TTP WR1000.

3-42. **Tachometer TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the tachometer circuitry.

STATEMENT NUMBER	
TA1000	Activate Service Aid 14 with tape unloaded. Check the signals at TP 70 and TP 72. Are they both a TTL clock that is high for 40.0 ±10 microseconds then low for 30.0 ±10 microseconds? YES = TA1020 NO = TA1010
TA1010	Problem is tachometer assembly, a bad cable connection, or U19T. When repaired, refer to TA1000.
TA1020	Is the signal at U18T-3 a clock that is high for 70.0 ±15 microseconds then low for 1.0 ±0.4 microseconds? YES = TA1060 NO = TA1030
TA1030	Is U18R-2 a 1.0 ±0.001MHz clock? YES = TA1050 NO = TA1040
TA1040	Problem is U8P. When repaired and U18R-2 is correct, refer to TA1000.
TA1050	The problem is U17R, U12F, U18T, or one of the destination IC's U18N, U17N, or U17T affecting the signal. When repaired, refer to TA1000.
TA1060	Is the signal at U18R-15 a clock that goes high for 1.0 ±0.4 microseconds then goes low for 70.0 ±15 microseconds? YES = TA1100 NO = TA1070
TA1070	Is the signal at TP 67 always low? YES = TA1080 NO = TA1090
TA1080	Problem is U18R, U18T, U17P, or U18P. When repaired, refer to TA1000.
TA1090	Problem is U18R, U17T, U18T, U17M, or U14L. When repaired, refer to TA1000.
TA1100	Is the signal PIASTR* (U17M-8) a clock that is low for 0.5 ±0.3 microsecond? YES = TA1120 NO = TA1110
TA1110	Problem is U17M, U17T, U18T, or U14L. When repaired, refer to TA1000.

STATEMENT NUMBER		
TA1120	Is the signal P1AØ (U17P-14) a 1.0 ±0.3 microsecond square-wave clock?	
	YES = TA1130	NO = TA1200
TA1130	Is the signal P1A1 (U17P-13) a 2.0 ±0.5 microsecond square-wave clock?	
	YES = TA1140	NO = TA1200
TA1140	Is the signal P1A2 (U17P-12) a 4.0 ±1.0 microsecond square-wave clock?	
	YES = TA1150	NO = TA1200
TA1150	Is the signal P1A3 (U17P-11) an 8.0 ±2.0 microsecond square-wave clock?	
	YES = TA1160	NO = TA1200
TA1160	Is the signal P1A4 (U18P-14) a 20.0 ±4.0 microsecond square-wave clock?	
	YES = TA1170	NO = TA1200
TA1170	Is the signal P1A5 (U18P-13) a 35.0 ±8.0 microsecond square-wave clock?	
	YES = TA1180	NO = TA1200
TA1180	Is the signal P1A6 (U18P-12) a clock that is high for greater than 1 microsecond and less than 6 microseconds?	
	YES = TA1190	NO = TA1200
TA1190	Is the signal P1A7 (U18P-11) always low?	
	YES = TA1210	NO = TA1200
TA1200	Problem is U17P, U18P, U17T, U14L, U18R, or U18T. When repaired, refer to TA1000.	
TA1210	Is the signal P1B4 (U18N-14) a 70.0 ±12.0 microsecond square-wave clock?	
	YES = TA1220	NO = TA1250
TA1220	Is the signal P1B5 (U18N-13) a 140.0 ±20.0 microsecond square-wave clock?	
	YES = TA1230	NO = TA1250

STATEMENT NUMBER	
TA1230	Is the signal P1B6 (U18N-12) a 280.0 ±40.0 microsecond square-wave clock? YES = TA1240 NO = TA1250
TA1240	Is the signal P1B7 (U18N-11) always low? YES = TA1260 NO = TA1250
TA1250	Problem is U18N, U14L, or U17T. When repaired, refer to TA1000.
TA1260	Either CTCCLK0 (U17N-4), or CTCCLK1 (U17N-1) should be a 30.0 ±10.0 microsecond square-wave clock while the other clock should be low. Is it? YES = TA1270 NO = TA1280
TA1270	Step the test program by pressing the LOAD switch until the takeup motor changes direction. Check CTCCLK0 (U17N-4) and CTCCLK1 (U17N-1). Are the results the opposite of those observed in step TA1260? YES = TA1290 NO = TA1280
TA1280	Problem is U17N, U18N, U14L, or U14T. When repaired, refer to TA1000.
TA1290	Replace U14L and U14N. If the MTSU is still failing, we are unable to determine the fault.

3-43. **Interface Lines TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the interface lines (Service Aid 21).

STATEMENT NUMBER	
TI1000	**NOTE:** Pullups are required to check signals at the interface. If the MTSU is connected in a daisy-chain configuration and the computer system is using one of the other MTSU's, it will be necessary to change the failing MTSU's unit number to a value that will not be selected or polled by the computer. Example - If there are four MTSU's in the daisy-chain, change the unit number of the failing MTSU to unit 6. Activate Service Aid 21 to allow the following interface signals to toggle. This provides a loop to look at signals that may only occur once during normal operation. Which of the following interface signals are failing? IONL - refer to TTP TI1010 IRWD - refer to TTP TI1110 IFBY - refer to TTP TI1190 IRDY - refer to TTP TI1210 IDBSY - refer to TTP TI1230 IFPT - refer to TTP TI1250 ILDP - refer to TTP TI1270 IEOT - refer to TTP TI1290
TI1010	Is the signal P3A4 (TP 81) high for 5.0 ±1.0 microseconds? YES = TI1310 NO = TI1020
TI1020	Is the signal PULSE I (U2V-5) toggling? YES = TI1030 NO = TI1050
TI1030	Is the signal at U2V-2 toggling? YES = TI1040 NO = TI1060
TI1040	Problem is U2V, U6V, U8V, or U10L. When repaired, refer to TTP TI1000.
TI1050	Problem is U2W or U2V. When repaired and PULSE I is toggling, refer to TTP TI1000.
TI1060	Is the signal at U3V-1 always low? YES = TI1080 NO = TI1070

STATEMENT NUMBER	
TI1070	Problem is U2W, U4V, or U2V. When repaired, refer to TTP TI1000.
TI1080	Is the interface signal IRWU (U4W-9) low? YES = TI1090 NO = TI1100
TI1090	Problem is U4W, U10W, or the controller. When repaired, refer to TTP TI1000.
TI1100	Problem is U4W, U4V, U5V, or U3V. When repaired, refer to TTP TI1000.
TI1110	Is the signal at TP 87 high for 5.0 ±1.0 microseconds? YES = TI1310 NO = TI1120
TI1120	Is the signal PULSE 2 (U3V-10) toggling? YES = TI1140 NO = TI1130
TI1130	Problem is U2W or U3V. When repaired and U3V-10 is toggling, refer to TTP TI1000.
TI1140	Is the signal PULSE 3 (U4V-1) toggling? YES = TI1160 NO = TI1150
TI1150	Problem is U2W or U4V. When repaired, refer to TTP TI1000.
TI1160	Is the signal at U5W-10 toggling? YES = TI1170 NO = TI1180
TI1170	Problem is U2V, U3V, U4V, or U10V. When repaired and the signal at TP 87 is toggling, refer to TTP TI1000.
TI1180	Problem is U5W, U7V, or U2W. When repaired and U5W-10 is toggling, refer to TTP TI1000.
TI1190	Is the signal at TP 84 toggling? YES = TI1310 NO = TI1200
TI1200	Problem is U7V, U3V, U2W, or U7W. When repaired, refer to TTP TI1000.
TI1210	Is the signal at TP 82 toggling? YES = TI1310 NO = TI1220

STATEMENT NUMBER		
T11220	Problem is U7V, U2W, or U7W. When repaired and the signal at TP 82 is toggling, refer to TTP T11000.	
T11230	Is the signal at TP 86 toggling?	
	YES = T11310	NO = T11240
T11240	Problem is U7V, U7W, or U2W. When repaired and the signal at TP 86 is toggling, refer to TTP T11000.	
T11250	Is the signal at TP 83 toggling?	
	YES = T11310	NO = T11260
T11260	Problem is U7W, U7V, or U2W. When repaired and TP 83 is toggling, refer to TTP T11000.	
T11270	Is the signal at TP 78 toggling?	
	YES = T11310	NO = T11280
T11280	Problem is U7V, U2W, U8V, or U5W. When repaired and TP 78 is toggling, refer to TTP T11000.	
T11290	Is the signal at TP 85 toggling?	
	YES = T11310	NO = T11300
T11300	Problem is U7V, U2W, or U8V. When repaired and the signal at TP 85 is toggling, refer to TTP T11000.	
T11310	In order to check out the output interface gate it will be necessary to have the interface unit select lines equal to the MTSU unit number. Is the signal FSEL (U8V-13) always high?	
	YES = T11340	NO = T11330
T11330	Problem is U6V, U6W, or the unit select switch U8W. When repaired, refer to TTP T11000.	
T11340	Is the signal ONLSEL (TP 80) toggling?	
	YES = T11380	NO = T11350
T11350	Is the signal at TP 81 toggling?	
	YES = T11360	NO = T11010
T11360	Is the signal at U6V-13 toggling?	
	YES = T11370	NO = T11110

STATEMENT NUMBER	
TI1370	Problem is U6V or one of the destination IC's U8V, U7W, U4R, U17V, U17X, U18X, or U20X affecting the signal. When repaired, refer to TTP TI1000.
TI1380	Problem is U7W, U8V, U9V, cable connection between drive and controller, or the controller. When repaired, refer to TTP TI1000.

3-44. **EOT and BOT TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the BOT and EOT circuitry (Service Aids 22 and 23).

STATEMENT NUMBER		
BE1000	Switch MTSU power on to drive unit without a reel of tape installed. To check BOT, measure the voltage drop across R287. Is the voltage greater than 0.9 volt?	
	YES = BE1010	NO = BE1070
BE1010	To check EOT, measure the voltage drop across R292. Is the voltage greater than 0.9 volt?	
	YES = BE1020	NO = BE1070
BE1020	Insert a reel of tape and hand thread the tape through the tape path and around the takeup hub. Position the reflector strip away from the sensor. Is the voltage across R287 less than 0.3 volt?	
	YES = BE1030	NO = BE1070
BE1030	Is the voltage across R292 less than 0.3 volt?	
	YES = BE1040	NO = BE1070
BE1040	Position the BOT reflector marker in front of the sensor. Verify the tape is pulled tight and doesn't have any slack. Is the voltage drop across R287 greater than 1.3 volts?	
	YES = BE1050	NO = BE1070
BE1050	Position the EOT reflector marker in front of the sensor. Is the voltage drop across R292 greater than 1.3 volts?	
	YES = BE1060	NO = BE1070
BE1060	If the MTSU doesn't detect the EOT or BOT marker during operation, problem is U2R, R343, or R342. Once repaired, refer to TTP BE1000.	

STATEMENT NUMBER	
BE1070	Is P4 pin 15 a 4.4 ±0.5Vdc level? YES = BE1090 NO = BE1080
BE1080	Problem is R298 or C204. When P4 pin 15 is correct, refer to TTP BE1000.
BE1090	Problem is the cables or the EOT/BOT assembly. When repaired, refer to TTP BE1000.

3-45. **Compliance Arm TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the compliance arm circuitry (Service Aid 24).

STATEMENT NUMBER	
CA1000	Switch MTSU power on and activate Service Aid 24. The compliance arm should be at its full rest position. Measure the voltage at TP 64. Is it less than 4.1Vdc and greater than 2.6Vdc? YES = CA1010 NO = CA1030
CA1010	Pull the compliance arm fully against the front stop. Is the voltage at TP 64 greater than 0.0Vdc? YES = CA1020 NO = CA1160
CA1020	Is the voltage difference, from the readings taken in steps CA1000 and CA1010, between 2.6Vdc and 3.6Vdc? YES = CA1200 NO = CA1190
CA1030	Is TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5 ±0.5kHz sawtooth signal? YES = CA1110 NO = CA1040
CA1040	Is the signal CTCZC2 (U18M-11) a clock less than 42.0kHz and greater than 40.0kHz? YES = CA1060 NO = CA1050
CA1050	Problem is U14N or U18M. When repaired and the signal CTCZC2 is correct, refer to TTP CA1000.
CA1060	Disconnect the cable connector from P4. Is TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5kHz sawtooth signal? YES = CA1070 NO = CA1080

STATEMENT NUMBER	
CA1070	Problem is a short in the cable assembly or air capacitor assembly. When repaired, refer to TTP CA1000.
CA1080	Is U17M-6 a 20.8 ±1.0kHz clock? YES = CA1100 NO = CA1090
CA1090	Problem is U17M or U18M. When repaired, refer to TTP CA1000.
CA1100	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1110	Measure the signal at TP 65. Is it a 4.0Vdc minimum, 10.5 ±0.5kHz clock? YES = CA1120 NO = CA1130
CA1120	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1130	Is P4 pin 20 a 0.2Vdc minimum, 10.5 ±0.5kHz clock? YES = CA1140 NO = CA1150
CA1140	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1150	Problem is a bad cable connection or air capacitor. When repaired, refer to TTP CA1000.
CA1160	Is the signal at TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5 ±0.5kHz sawtooth signal? YES = CA1170 NO = CA1140
CA1170	Is the signal at TP 65 a 2.0Vdc maximum, 10.5 ±0.5kHz clock? YES = CA1180 NO = CA1190
CA1180	Problem is U10N or supporting components. When repaired, refer to TTP CA1000.
CA1190	Problem is U20N, supporting components, or the air capacitor assembly. When repaired, refer to TTP CA1000.
CA1200	With the compliance arm at its full rest position measure the voltage at TP 20. Is it greater than -8.0Vdc and less than 0.0Vdc? YES = CA1210 NO = CA1220

STATEMENT NUMBER	
CA1210	With the compliance arm fully against the front stop, is voltage at TP 20 less than 11.0Vdc and greater than 2.0Vdc? YES = CA1240 NO = CA1220
CA1220	Is the signal VOUT 1 (U3M-1) at a -0.2 ±0.4Vdc level? YES = CA1230 NO = Test D to A using Service Aid 11
CA1230	Problem is U5E or U4B. When repaired, refer to TTP CA1000.
CA1240	Switch MTSU power off. Using a jumper wire, ground pins 10 and 11 of U4B. Switch MTSU power on while pressing the TEST switch until the UNLOAD indicator illuminates. Does the voltage at TP 25 swing greater than +3.0Vdc and less than -3.0Vdc when the compliance arm is moved back and forth between its limits? YES = CA1260 NO = CA1250
CA1250	Problem is U4B or U3D. When repaired, refer to TTP CA1000.
CA1260	Problem is U12L. If the MTSU still fails, refer to the next section recommended in the troubleshooting table. Otherwise we are unable to determine the cause of the failure.

3-46. **Reel Seat Sensor and Tape-In-Path Sensor TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the reel seat sensor and tape-in-path sensor (Service Aid 31).

STATEMENT NUMBER	
HS1000	If testing the reel seat or file protect sensor, refer to TTP HS1010. If testing the tape-in-path sensor, refer to TTP HS1130.
HS1010	Install a tape reel with a write ring and activate Service Aid 31. Is the supply hub slowly rotating in the counterclock wise direction? YES = HS1020 NO = SE1000
HS1020	Does the UNLOAD indicator flash "on" when the file protect tab passes the sensor? YES = HS1030 NO = HS1060

STATEMENT NUMBER	
HS1030	Does the UNLOAD indicator flash "on" when the reel seat tab passes the sensor? YES = HS1040 NO = HS1060
HS1040	When slowing the supply reel down by hand, does the UNLOAD indicator flash twice when the reel seat tab passes by the sensor? YES = HS1045 NO = HS1050
HS1045	Stop Service Aid 31 and remove the reel of tape from the MTSU. Press the LOAD switch and verify the MTSU doesn't engage the hub lock. If not, the hub sensors are working correctly. If the MTSU does engage the hub lock, refer to TTP HS1080.
HS1050	Problem is incorrect supply hub height or the reel seat tab is bent out of place. When repaired, refer to TTP HS1000.
HS1060	Does P2A1 (TP 21) toggle as the tab passes by the sensor? YES = HS1070 NO = HS1080
HS1070	Problem is U12L. When repaired and the UNLOAD indicator is working, refer to TTP HS1000.
HS1080	The signal at P4 pin 7 should be less than 0.15Vdc when a tab is not located in front of the sensor and greater than 0.3Vdc when a tab is located in front of the sensor. Is it? YES = HS1090 NO = HS1100
HS1090	Problem is U19T or U12L. When repaired, refer to TTP HS1000.
HS1100	Is P4 pin 2 at a 4.4 $\pm$0.5Vdc level? YES = HS1120 NO = HS1110
HS1110	Problem is R298, C204, or broken PWB etch going to P4 pin 2. When P4 pin 2 is correct, refer to TTP HS1000.
HS1120	Problem is U19T, the tab sensors, cable connection, or incorrect hub height. When repaired, refer to TTP HS1000.
HS1130	The following checks the tape-in-path sensor. Activate Service Aid 31. Is the LOAD/REWIND indicator illuminated on the fron panel? YES = HS1140 NO = HS1150

STATEMENT NUMBER	
HS1140	Place your hand between the tape-in-path transmitter and receiver sensors. Does the LOAD/REWIND indicator extinguish? YES = HS1140 NO = HS1200
HS1145	The tape-in-path sensor is working correctly. If a problem still exists, refer to TTP HS1170 and TTP HS1210.
HS1150	Is P2A0 (TP 69) high? YES = HS1160 NO = HS1170
HS1160	Problem is U12L. When repaired, refer to TTP HS1000.
HS1170	Is P4 pin 9 greater than 0.3Vdc? YES = HS1180 NO = HS1190
HS1180	Problem is U19T or U12L. When repaired and TP 69 is high, refer to TTP HS1000.
HS1190	Problem is with tape-in-path sensors, sensor alignment, or a cable connection problem. When repaired, refer to TTP HS1000.
HS1200	Is the signal P2A0 (TP 69) low? YES = HS1160 NO = HS1210
HS1210	Is P4 pin 9 less than 0.15Vdc? YES = HS1220 NO = HS1230
HS1220	Problem is U19T or U12L. When repaired and TP 69 is low, refer to TTP HS1000.
HS1230	Problem is U19T or the light beam between the tape-in-path source and transmitter receiver has not been broken. When repaired, refer to TTP HS1000.

3-47. **Hub Lock and Door Lock TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the hub lock door and lock circuitry (Service Aid 32).

STATEMENT NUMBER	
HD1000	During this test the supply hub should rotate counter-clockwise while activating the hub lock and door lock solenoids. Also, if both the top cover and front door are not closed, the ON-LINE indicator should illuminate. Which of the following best describes the observed failure, if any? a. The hub lock solenoid is not working - refer to TTP HD1010. b. The hub lock solenoid is not working - refer to TTP HD1080. c. The top cover and front door are closed but the ON-LINE indicator is illuminated - refer to TTP HD1110.
HD1010	Is P3 pin 13 at a 24.0 ±5.0Vdc level? YES = HD1020 NO = HD1050
HD1020	Is the signal at TP 74 switching between 24.0Vdc ±5.0Vdc and 0.5Vdc? YES = HD1030 NO = HD1040
HD1030	Problem is cable connection or hub lock solenoid. When repaired, refer to TTP HD1000.
HD1040	Problem is U12L, R307, Q39, or a bad cable connection. When repaired, refer to TTP HD1000.
HD1050	Is P3 pin 4 at a 24.0 ±5.0Vdc level? YES = HD1060 NO = HD1070
HD1060	Problem is cable connection from power supply or power supply board. When repaired and P3 pin 4 is correct, refer to TTP HD1000.
HD1070	Problem is P3 pin 13 and P3 pin 4 should be connected. When repaired, refer to TTP HD1000.
HD1080	Is the signal at TP 75 switching between 24 ±5Vdc and 0.5Vdc? YES = HD1090 NO = HD1100
HD1090	Problem is front-panel door lock solenoid. When repaired and TP 75 is correct, refer to TTP HD1000.

STATEMENT NUMBER	
HD1100	Problem is U12L, R308, Q40, or a bad cable connection. When repaired and TP 75 is going to ground, refer to TTP HD1000.
HD1110	With both front panel door and top cover closed, is the signal P2A2, U12L-13 low? YES = HD1120 NO = HD1040
HD1120	Open one door at a time. Is P2A2 (U12L-13) high? YES = HD1030 NO = HD1040
HD1130	Problem is U12L. When repaired and ON-LINE indicator is working correctly, refer to TTP HD1000.
HD1140	The problem is the cable connection, U12L or the microswitch. When repaired, refer to TTP HD1000.

3-48. **Blower Motor TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the blower motor circuit (Service Aid 34).

STATEMENT NUMBER	
BL1000	Activate Service Aid 34 with tape unloaded. Does the blower motor start running? YES = BL1010 NO = BL1020
BL1010	Press the LOAD switch once. The LOAD indicator should extinguish and the blower motor should come to a stop. Does it? YES = DONE NO = BL1070
BL1020	Is P5 pin 2 between +5.0Vdc and +6.0Vdc? YES = BL1030 NO = BL1040
BL1030	Problem is the blower motor, power supply, or a cable connection. When repaired, refer to TTP BL1000.
BL1040	Is the signal P2B4 (U3K-12) low? YES = BL1050 NO = BL1060
BL1050	Problem is U3K or supporting components. When problem is repaired, refer to TTP BL1000.

STATEMENT NUMBER	
BL1060	Problem is U12L or Service Aid 34 wasn't selected. When repaired, refer to TTP BL1000.
BL1070	Is P5 pin 2 less than +0.5Vdc? YES = BL1080 NO = BL1090
BL1080	Problem is the power supply or motor. When repaired, refer to TTP BL1000.
BL1090	Is the signal P2B4 (U3K-12) high? YES = BL1110 NO = BL1100
BL1100	Problem is U12L. When repaired, refer to TTP BL1000.
BL1110	Problem is U3K or supporting components. When repaired, refer to TTP BL1000.

3-49. **Drive Selection TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the drive selection circuits.

STATEMENT NUMBER	
DS1000	The following should be used when the system diagnostic program is unable to select the MTSU. Are the unit address swithces set to equal the MTSU number being tested? YES = DS1020 NO = DS1010
DS1010	Change unit select switch to equal the address of MTSU being tested. When correct, refer to TTP DS1000.
DS1020	Is the signal FSEL (U6V-8) high? YES = DS1060 NO = DS1030
DS1030	Are the interface unit select lines IFAD, ITAD1, ITAD0 set correctly with the unit number being tested? YES = DS1050 NO = DS1040
DS1040	Problem is interface cables or controller. When problem is corrected and interface lines equal unit number, refer to TTP DS1000.

STATEMENT NUMBER	
DS1050	FSEL (U6V-8) should be high. If not, the problem is U6V, U6W, or unit select switch U8W. When problem is corrected, refer to TTP DS1000.
DS1060	Is the MTSU front panel ON-LINE indicator illuminated? YES = DS1080 NO = DS1070
DS1070	Press the ON-LINE switch on the front panel to place the drive on-line. Did the ON-LINE indicator illuminate? YES = DS1080 NO = DS1075
DS1075	Problem is switch panel, bad cable connection, U17L, or U10L. When repaired, refer to TTP DS1000.
DS1080	Is the signal IONL (U8V-3) low? YES = DS1100 NO = DS1090
DS1090	The problem is U8V, U2V, U2W, or U6V. When the problem is corrected and IONL (U8V-3) is low, refer to TTP DS1000.
DS1100	Is the signal IRDY (U7W-6) low? YES = DS1160 NO = DS1110
DS1110	Is the signal at TP 80 high? YES = DS1120 NO = DS1130
DS1120	Problem is U7W, U7V, or U2W. When repaired and IRDY (U7W-6) is low, refer to TTP DS1000.
DS1130	Is the signal at U3V-8 always high? YES = DS1140 NO = DS1150
DS1140	Problem is U6V or one of the destination IC's U8V, U7W, U4R, U17X, U17V, U18X, or U20X affecting the signal. When repaired and TP 80 is high, refer to TTP DS1000.
DS1150	Troubleshoot the IRWD interface line using Service Aid 21. Refer to TTP TI1000.
DS1160	If the MTSU is on-line and ready, the problem must be with the interface cables or the controller. When the problem is corrected, the system program should be able to select the MTSU.

3-50. **Command Lines TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the command lines.

STATEMENT NUMBER	
CL1000	It is the responsibility of the system program to detect a failure in this area. Which of the following best describes the failure if any? a. A command was sent; however, no tape motion occurred and IFBY did not go true. If so, refer to TTP CL1010. b. The tape drive fails with an illegal command fault code. If so, refer to TTP CL1070. c. The tape drive executes a different command than was sent. If so, refer to TTP CL1070.
CL1010	Put the system program in a loop to continually send a no-operation command. Is the signal IGO, P1, pin 8 going low for a minimum of 1 microsecond and no longer than 1 second? YES = CL1030 NO = CL1020
CL1020	Problem is the controller not sending an IGO pulse, bad cable connection, or failure of U3W, U5V, or U5W. When repaired, refer to TTP CL1000.
CL1030	Is the signal FSEL (U6V-8) high during the time IGO is low? YES = CL1040 NO = DS1000
CL1040	Is the signal POASTR* (U5V-11) at a low level only while IGO, U5W-13 is low? YES = CL1050 NO = CL1060
CL1050	Problem is U8L. When repaired, refer to TTP 1000.
CL1060	Problem is U5W, U5V, or U8L. When repaired, refer to TTP CL1000.
CL1070	Problem is U4W, U5W, U3W, or U8L. When repaired, refer to TTP CL1000.

3-51. **Read Formatter TTP.** This TTP describes the diagnostic steps required to check the read formatter logic. The circuitry is located on pages 7 - 10 of schematic drawing 360103-309.

STATEMENT NUMBER	
RF1000	Determine if the errors are being caused by the Write or Read circuits by reading a tape that is known to be good. If the errors persist while reading the good tape, the problem is in the read circuits and this TTP should be used. If errors are not detected while reading the good tape, it can be assumed that the write circuitry is the cause of the original errors and the procedure starting at WR1000 should be used.

NOTE

A good tape is defined as a tape containing record blocks that are greater than 18 and less than 2046 bytes, that the data in each block guarantees all data lines are changing, and there are no hard errors or corrected errors.

Before beginning, verify the following:

a. All cables are mated with the appropriate connectors, are properly seated, and are not inverted.

b. The AC line voltage is within operating limits and has the correct frequency.

c. The head, tape cleaner, and tape guides are clean and in good condition.

To use this troubleshooting procedure remove the write enable ring from tape and load tape on the transport. Unless otherwise specified, select Service Aid 23 for 25 ips operation.

This document covers two approaches to locating the failure. The first approach discussed is when the computer system can provide failure symptom information. The second approach is when the computer system is incapable of supplying information other than that the drive doesn't work.

Failure Information (supplied by system)

With failure information the circuitry most likely to be at fault can be determined. Which of the following best describes the failure?

a. Transport doesn't send any read strobes or read data information to controller. Refer to TTP RF1010.

STATEMENT NUMBER

RF1000 (cont.)

b. Transport does send read data but is also sending hard error or corrected error information to controller. Refer to TTP RF1020.

c. Transport doesn't send or is always sending file mark status to controller. Refer to TTP RF3100.

d. Transport doesn't send or is always sending ID burst status to controller. Refer to TTP RF3000.

e. Transport sends incorrect data without indicating a hard error to controller. Refer to TTP RF3300.

f. The transport goes into a runaway condition when sent a read command to controller. Refer to TTP RF1010.

If the symptom isn't described above or if after following the statements called out the problem wasn't resolved, it will be necessary to step through each troubleshooting routine to locate the failure. Follow the instruction under "System Incapable of Supplying Failure Information."

System Incapable of Supplying Failure Information

Read Amplifiers - Starting at RF4000.
Read Control - Starting at RF2300.
Read Multiplexer - Starting at RF7100.
Read Clock - Starting at RF2000.
Read Data Lines - Starting at RF3300.
Read Strobe - Starting at RF3200.
Scan Generator - Starting at RF5000.
File Mark - Starting at RF3100.
Error Detect and Postamble - Starting at RF7500.
ID Burst - Starting at RF3000.
Read Control - Starting at RF2100.
Data Extractors - Starting at RF6100.
Skew Buffer - Starting at RF7300.

If after checking all the above circuits the failure still exists, we are unable to determine the cause of the problem or the failure is not located in the read formatter logic.

RF1010

Since the failure could be located in several different areas, it will be necessary to isolate the problem by checking the following circuits:

a. Read Control - Refer to TTP RF2300.
b. Read Multiplexer - Refer to TTP RF7100.
c. Read Control Register - Refer to TTP RF2100.
d. Read Strobe - Refer to TTP RF3200.
e. Read Data - Refer to TTP RF3300.
f. Return to TTP RF1000.

STATEMENT NUMBER	
RF1020	Isolate the problem by checking the read formatter circuits in the following order: a. Read Amplifiers - Refer to TTP RF4000. b. Read Multiplexers - Refer to TTP RF7100. c. Error Detect and Postamble - Refer to TTP RF7500. d. Return to TTP RF1000.
RF2000	In this section the read clock circuitry will be checked. The read clock logic is located in page 9 of the schematic drawing 360103-309. Load the good tape and select Service Aid 23 for 25 ips. Press the LOAD switch once and tape motion should stop. Measure the frequency at TP 93. Is it between 870kHz and 890kHz? YES = RF2010 NO = RF2030
RF2010	Initiate high speed, then stop tape motion. Is the clock at TP 93 between 3.48MHz and 3.56MHz? YES = RF2020 NO = RF2015
RF2015	Is the signal P0B5 zero (U12F-8) low if 25 ips is selected or high if 100 ips is selected? YES = RF2035 NO = RF2085
RF2020	Initiate low speed tape motion. Are the signals DCLK1 (TP 3) and DCLK2 (TP10) both toggling? YES = RF2025 NO = RF6100
RF2025	The read clock circuitry appears to be working correctly; return to the main troubleshooting routine that sent you here.
RF2030	Is the signal at U3G-8 always high? YES = RF2040 NO = RF2015
RF2035	Problem is U3G, U5G, U7H, U2G, or supporting components. When repaired, refer to TTP RF1000.
RF2040	Is the signal at U5G-1 a 40.0 $\pm$1.0kHz clock? YES = RF2045 NO = RF2070
RF2045	Is the signal at U3G-6 toggling? YES = RF2050 NO = RF2035

STATEMENT NUMBER		
RF2050	Is the signal at U5G-3 toggling?	
	YES = RF2035	NO = RF2055
RF2055	Is the signal at TP 93 toggling?	
	YES = RF2060	NO = RF2065
RF2060	Problem is U3H, U2H, or U1J. When repaired and the signal at U5G-3 is toggling, refer to TTP RF1000.	
RF2065	Problem is U2G or one of the destination chips U1H, U2H, U3H, U5H, U5F, U6A, U6B, U6F, U6G, U7A, U7B, U7D, U7F, U8F, U8E, U9A, U9B, U9C, U9D, U9F, U10B, U10C, U10D, U10E, U11D, U12V, U13A, U13B, U13C, U13D, U13E, U13F, U13G, U13V, U14V, U15V, or U19V. When repaired, refer to TTP RF1000.	
RF2070	Is the signal at U9R-3 an 80.0 ±2.0kHz clock?	
	YES = RF2075	NO = WR1000
RF2075	Is U7E-2 always low?	
	YES = RF2080	NO = RF2300
RF2080	Problem is U7E, U9R, or U5G. When repaired, refer to TTP RF1000.	
RF2085	Problem is with U8L, U12F, or one of the destination IC's U7H or U10H. When repaired, refer to TTP RF1000.	
RF2100	In this section the read control register will be checked. The read control logic is located on page 10 of the schematic drawing 360103-309.	
	Are the signals ENFMG (U18V-2), ENRD (U18V-7), and FWD (U18V-10) all toggling?	
	YES = RF2110	NO = RF2130
RF2110	Is the signal at U18V-15 always low?	
	YES = RF2120	NO = RF2150
RF2120	The read control register is working correctly. Return to the main troubleshooting flow.	

STATEMENT NUMBER	
RF2130	Is the signal PULSE 5 (U18V-9) toggling? YES = RF2150 NO = RF2140
RF2140	Problem is U2W, U18V, or U18W. When repaired, refer to TTP RF1000.
RF2150	If the failing signal was ENFMG the problem is caused by U18V, U2H, U5H, or U3K. If the failing signal was ENRD, the problem is caused by U18V, U19W, U19X, or U2J. If the failing signal was FWD, the problem is U18V or one of the destination IC's U12D, U12C, U12F, U12B, or U12G. If the failing signal was U18V-15, the problem is U18V or U17V. When the failure is repaired, refer to TTP RF1000.
RF2300	In this section the read control circuitry will be checked. The read control logic is located on page 9 of the schematic drawing 360103-309. Select Service Aid 23 for 25 ips operation. Check the following RDROP signals. Are they all toggling? RDROPP* U12H-5 RDROP0* U12H-1 RDROP1* U12H-14 RDROP2* U12H-2 RDROP3* U12H-7 RDROP4* U12H-15 RDROP5* U12H-4 RDROP6* U12H-6 RDROP7* U12H-3 YES = RF2310 NO = RF4020
RF2310	Are both the signals at U5H-14 and U5H-13 toggling? YES = RF2330 NO = RF2320
RF2320	Problem is U12H, U6H, U5H, U7E, or U3K. When repaired, refer to TTP RF1000.
RF2330	Is the signal PECLK (U5H-12) a clock between 870 and 890 kHz? YES = RF2340 NO = RF2000
RF2340	Is the signal BLOCK (U5H-10) toggling? YES = RF2350 NO = RF2380

STATEMENT NUMBER	
RF2350	Is the signal P3A2 (U2H-6) toggling? YES = RF2360 NO = RF2400
RF2360	Is the signal PENAB* (U3J-8) toggling? YES = RF2370 NO = RF2410
RF2370	The read control circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF2380	Is the signal ENFMG (U5H-15) toggling? YES = RF2390 NO = RF2100
RF2390	Problem is U5H, U2J, or U1H. When repaired, refer to TTP RF1000.
RF2400	Problem is U5H, U1H, U2H, or U10L. When repaired, refer to TTP RF1000.
RF2410	Is the signal at U2J-8 toggling? YES = RF2420 NO = RF2430
RF2420	Problem is U3J or one of the destination IC's U11C, U12E, U13E, U13F, U13H, U11B, U13B, U11F, U11E, or U13C. When repaired, refer to TTP RF1000.
RF2430	Is the signal ENRD (U2J-9) toggling? YES = RF2440 NO = RF2100
RF2440	Is U5H-2 always low? YES = RF2450 NO = RF3100
RF2450	Problem is with U5H, U2J, or one of the destination IC's U3J, U12V, U6F, U9F, U6G. When repaired, refer to TTP RF1000.
RF3000	In this section the ID burst logic will be checked. The circuitry is located on page 9 of schematic drawing 360103-309. Remove the write enable ring from a good tape that is written in 1600 bpi phase encode and install in the drive. Select Service Aid 23 and press the LOAD switch for 25 ips operation. As the drive performs the read from load point, the drive should first send the ID burst status. It is necessary to terminate Service Aid 23 and reselect it for every ID burst pulse. A better troubleshooting loop can be accomplished if the command string of read, rewind, and loop can be executed by the computer system.

STATEMENT NUMBER	
RF3000 (con't.)	Does U6H-2 go high for a minimum of 4 milliseconds? YES = RF3010 NO = RF3060
RF3010	Does the signal ENFMG (U3K-5) go high when the BOT marker moves past the read/write head? YES = RF3020 NO = RF2300
RF3020	The signal IDENT P2 pin 16 should remain high when reading from load point. Does it? YES = RF3040 NO = RF3030
RF3030	The problem is U6V, U3K, cable connection between drive and controller, or the controller. When repaired, refer to TTP RF1000.
RF3040	In order to check out the output interface gate, the drive must be on-line and executing a read command. Does P2 pin 16 go low when reading from BOT? YES = RF3050 NO = RF3030
RF3050	The ID burst circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF3060	The problem is U12H, U6H, or U6V. When repaired, refer to TTP RF1000.
RF3100	In this section the file mark logic will be checked. This circuitry is located on page 9 of schematic drawing 360103-309. Load a scratch tape that is write-enabled. Select Service Aid 21 and adjust R115 so the UNLOAD indicator is always illuminated. Is the signal P3A3 (U5H-6) toggling? YES = RF3110 NO = RF3150
RF3110	U17X-8 should always be high. Is it? YES = RF3130 NO = RF3120
RF3120	The problem is U17X cable connection between drive and controller, or the controller. When repaired, refer to TTP RF1000.

STATEMENT NUMBER	
RF3130	In order to check out the interface gate, the drive must be on-line and in a loop writing file marks. Does U17X-8 toggle? YES = RF3140 NO = RF3120
RF3140	The file mark circuitry is working correctly. Return to the troubleshooting routine that sent you here. Refer to paragraph 6-17 for instructions on final read threshold adjustment.
RF3150	Is the signal ENFMG (U5H-1) toggling? YES = RF3160 NO = RF2300
RF3160	Is the signal PECLK (U5H-4) toggling? YES = RF3170 NO = RF2000
RF3170	Check the following signals. Are the signals RDROP1*, RDROP3*, RDROP4* always low and the rest toggling? YES = RF3180 NO = RF4020 RDROPP* U12H-5 RDROP1* U12H-14 RDROP3* U12H-7 RDROP5* U12H-4 RDROP7* U12H-3 RDROP0* U12H-1 RDROP2* U12H-2 RDROP4* U12H-15 RDROP6* U12H-6
RF3180	The problem is U12H, U6H, U5H, or U17X. When repaired, refer to TTP RF1000.
RF3200	In this section the read strobe circuitry will be checked. The read strobe logic is located on page 10 of schematic drawing 360103-309. Load the good tape without the write enable ring. Select Service Aid 23 for 25 ips operation. Is there an active signal at U17W-5 with a positive going pulse width of 1.3 to 1.7 microseconds and with the same frequency (±5 kHz) as U17W-1? YES = RF3210 NO = RF3250
RF3210	The signal IRSTR (U17V-11) should always be high. Is it? YES = RF3230 NO = RF3220

STATEMENT NUMBER	
RF3220	Problem is with U17V, cable connection between drive and controller, or controller. When repaired, refer to TTP RF1000.
RF3230	In order to check out the output interface gate, the drive must be on-line and executing a read command. Is there an active signal at U17V-11? YES = RF3240 NO = RF3220
RF3240	The read strobe circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF3250	Is U7W-1 high and U7W-2 toggling? YES = RF3260 NO = RF7500
RF3260	Problem is U17W, U17V, or supporting components. When repaired, refer to TTP RF1000.
RF3300	In this section the data output logic will be checked. The data output circuitry is located on page 10 of schematic drawing 360103-309. Load the good tape without a write enable ring. Select Service Aid 23 for 25 ips operation. Check for a signal on U18W pins 2, 7, 10, and 15. Are they always low? YES = RF3330 NO = RF3310
RF3310	Is the signal PULSE5 (U18W-9) toggling? YES = RF3320 NO = RF2100
RF3320	Problem is U18W or U18X. When repaired, refer to TTP RF3300.
RF3330	Check the following locations. Do they all have a signal that is toggling? U19W-10 U19X-2U19X-5 U19W-12 U19X-15U19X-7 U19W-15 U19X-12U19X-10 YES = RF3370 NO = RF3340
RF3340	Are the signals at U19V-1, U19X-9, and U19X-1 all toggling? YES = RF3350 NO = RF7500

STATEMENT NUMBER	
RF3350	Is the signal PECLK (U19V-8) a clock between 870 and 890 kHz? YES = RF3360 NO = RF2000
RF3360	The problem is U19V, U19X, U19W, or one of the destination IC's U17V, U17X, U18X or U20X. When repaired, refer to TTP RF3300.
RF3370	Check the following locations. Are they all high? U17V-6 U17X-6 U20X-8 U17V-3 U20X-3 U20X-11 U17X-11 U20X-6 U18X-6 YES = RF3390 NO = RF3380
RF3380	Problem is with U17V, U17X, U18X, U20X, cable connection between drive and controller, or controller. When repaired, refer to TTP RF3300.
RF3390	In order to check out the interface gates the drive must be online and executing a read command. Are the following locations all toggling? U17V-6 U17X-6 U20X-8 U17V-3 U20X-3 U20X-11 U17X-11 U20X-6 U18X-6 YES = RF3399 NO = RF3380
RF3399	The read data circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF4000	In this section the read amplifiers will be checked. The read amplifier logic is on page 7 of schematic drawing 360103-309. Power up the transport and before loading a tape reel, check TP 94. Is it a level between 0.10 and 0.70 volt? YES = RF4010 NO = RF4220

STATEMENT NUMBER

RF4010

Initialize the drive to Service Aid 23 and initiate low speed. Does the signal on all the following test points swing between +1.0 and +8.0 and -1.0 and -8.0 volts?

YES = RF4015

Channel P = TP 50
Channel 0 = TP 44
Channel 1 = TP 46
Channel 2 = TP 48
Channel 3 = TP 52

NO = RF4110

Channel 4 = TP 40
Channel 5 = TP 56
Channel 6 = TP 42
Channel 7 = TP 54

RF4015

The input read amplifiers are presumed to be working correctly. Return to the TTP that sent you here.

RF4020

Initialize the drive to Service Aid 23 and select 25 ips. Do all the following locations have a signal that swings more positive than 1.0 volt and more negative than -1.0 volt?

YES = RF4040

Channel P = U15F-4
Channel 0 = U15C-4
Channel 1 = U15D-4
Channel 2 = U14F-4
Channel 3 = U15G-4

NO = RF4030

Channel 4 = U15A-4
Channel 5 = U15H-4
Channel 6 = U14C-4
Channel 7 = U14H-4

RF4030

Depending on which channel or channels are failing, replace the following components. When repaired, refer to TTP RF1000.

Channel P = U15F, C106, or R191
Channel 0 = U15C, C83, or R158
Channel 1 = U15D, C85, or R176
Channel 2 = U14F, C89, or R180
Channel 3 = U15G, C108, or R202
Channel 4 = U15A, C52 or R136
Channel 5 = U15H, C126 or R224
Channel 6 = U14C, C53 or R154
Channel 7 = U14H, C123 or R213

RF4040

Are all the following signals toggling?

YES = RF4060

RDATAP = U14D-8
RDATA0 = U14B-8
RDATA1 = U14D-10
RDATA2 = U14D-12
RDATA3 = U14G-10

NO = RF4050

RDATA4 = U14B-10
RDATA5 = U14G-8
RDATA6 = U14B-12
RDATA7 = U14G-12

STATEMENT NUMBER	
RF4050	Depending on which channel or channels are failing, replace the following components. When repaired, refer to TTP RF1000. RDATAP = U15F, U14D, OR U13D RDATA0 = U15C, U14B, OR U13A RDATA1 = U15D, U14D, OR U13D RDATA2 = U14F, U14D, OR U13D RDATA3 = U15G, U14G, OR U13G RDATA4 = U15A, U14B, OR U13A RDATA5 = U15H, U14G, OR U13G RDATA6 = U14C, U14B, OR U13A RDATA7 = U14H, U14G, OR U13G
RF4060	Are all the following signals toggling? YES = RF4080 NO = RF4070 RDROPP* = U14D-4 RDROP0* = U14B-4 RDROP1* = U14D-6 RDROP2* = U14D-2 RDROP3* = U14G-6 RDROP4* = U14B-6 RDROP5* = U14G-4 RDROP6* = U14B-2 RDROP7* = U14G-2
RF4070	Depending on which signal or signals are failing, replace the following components. When repaired, refer to TTP RF1000. RDROPP* = U15F, U14D, U13E, OR U12H RDROP0* = U15C, U14B, U13B, OR U12H RDROP1* = U15D, U14D, U13E, OR U12H RDROP2* = U14F, U14D, U13F, OR U12H RDROP3* = U15G, U14G, U13F, OR U12H RDROP4* = U15A, U14B, U13C, OR U12H RDROP5* = U15H, U14G, U13H, OR U12H RDROP6* = U14C, U14B, U13B, OR U12H RDROP7* = U14H, U14G, U13H, OR U12H
RF4080	Initiate 100 ips operation. Measure the signal at the following test points. Do they all swing between +0.3 to +0.7 volt and -0.3 to -0.7 volt? YES = RF4130 NO = RF4090 Channel P = TP 49 Channel 0 = TP 43 Channel 1 = TP 45 Channel 2 = TP 47 Channel 3 = TP 51 Channel 4 = TP 39 Channel 5 = TP 55 Channel 6 = TP 41 Channel 7 = TP 53

STATEMENT NUMBER	
RF4090	Measure the voltage across R114. Is it less than 0.2 volt? YES = RF4100 NO = RF4160
RF4100	Depending on which channel is failing, replace the following components. If after replacing the listed components the failure still exists, replace the head assembly. When repaired, refer to TTP RF1000. Channel P = Q31, U19F, C99, R197, C100, C102, or R198 Channel 0 = Q28, U19C, C73, R164, C74, C70, or R165 Channel 1 = Q29, U19D, C76, R167, C77, C79, or R169 Channel 2 = Q30, U19E, C95, R186, C96, C93, or C187 Channel 3 = Q32, U19G, C112, R208, C113, C115, or R209 Channel 4 = Q26, U19A, C60, R142, C61, C58, or R144 Channel 5 = Q34, U19I, C133, R230, C134, C129, or R231 Channel 6 = Q27, U19B, C64, R145, C65, C67, or R146 Channel 7 = Q33, U19H, C119, R219, C120, C117, or R220
RF4110	Depending on which channel or channels are failing, check the appropriate test point. Does the signal swing between +0.3 to +0.7 volt and -0.3 to -0.7 volt? YES = RF4120 NO = RF4100 Channel P = TP 49 Channel 0 = TP 43 Channel 1 = TP 45 Channel 2 = TP 47 Channel 3 = TP 51 Channel 4 = TP 39 Channel 5 = TP 55 Channel 6 = TP 41 Channel 7 = TP 53
RF4120	Depending on which channel is failing, replace the following components. When repaired, refer to TTP RF1000. Channel P = U17F Channel 0 = U17C Channel 1 = U17D Channel 2 = U17E Channel 3 = U17G Channel 4 = U17A Channel 5 = U17I Channel 6 = U17B Channel 7 = U17H
RF4130	Measure the peak voltage at TP 57. Is it greater than 0.1 volt? Use TP 1 for ground reference. YES = RF4140 NO = RF4150
RF4140	Select Service Aid 12 and measure the peak voltage at TP 57. Is it greater than 0.1 volt? Use ground TP 1 for reference. YES = RF4190 NO = RF4150

STATEMENT NUMBER	
RF4150	The read amplifiers appear to be working correctly. If the problem has not been found and corrected, return to the troubleshooting routine which brought you to the read amplifiers.
RF4160	Make the following measurements while alternating between 100 ips and 25 ips. Does the signal at U12F-10 toggle with each speed change? YES = RF4180 NO = RF4170
RF4170	Problem is U8L or U12F. When repaired, refer to TTP RF1000.
RF4180	Problem is U10H, Q25, or the supporting components. When repaired, refer to TTP RF1000.
RF4190	Is the signal P3B6 (U10L-33) high? YES = RF4200 NO = RF4210
RF4200	Problem is U10L or U12V. When repaired and U10L-33 is low, refer to TTP RF1000.
RF4210	Problem is U12V or the supporting components. When repaired and TP 57 is correct, refer to TTP RF1000.
RF4220	Measure the voltage at TP 94 while adjusting R115. Can the voltage be adjusted between 0.1 and 0.7 volt? YES = RF4230 NO = RF4240
RF4230	Adjust R115 per read threshold adjustment procedure, then refer to TTP RF1000.
RF4240	Problem is with U2N, U3M, or R115. When repaired, adjust R115 per read threshold adjustment procedure, then refer to TTP RF1000.
RF5000	The following guide should be used when troubleshooting the scan generator. The scan generator circuitry is located on page 9 of schematic diagram 360103-309. Are the following signals toggling: a (U8D-1) b (U8D-2) c (U8D-3)? YES = RF5010 NO = RF5040
RF5010	Is the signal SCANP (U7H-6) toggling? YES = RF5020 NO = RF5110

STATEMENT NUMBER	
RF5020	Are all eight SCAN signals toggling? To determine this, check the following locations: SCAN0, U8D-15 SCAN1, U8D-14 SCAN2, U8D-13 SCAN3, U8D-12 SCAN4, U8D-11 SCAN5, U8D-10 SCAN6, U8D-9 SCAN7, U8D-7 YES = RF5030 NO = RF5120
RF5030	The scan generator is working correctly. Return to the troubleshooting flow that sent you here.
RF5040	Is the signal PECLK (U7D-2) toggling? YES = RF5060 NO = RF5050
RF5050	Troubleshoot the PE clock generator starting at RF2000.
RF5060	Is the signal SCANP (U7H-6) always low? YES = RF5080 NO = RF5070
RF5070	Problem is U7D or one of the destination IC's U8D, U7C, U10F, U10G. When repaired, refer to TTP RF1000.
RF5080	Is the signal PSEL (U7H-5) high? YES = RF5100 NO = RF5090
RF5090	Problem is U7H or one of the destination IC's U10V, U7D, U8A. When repaired, refer to TTP RF1000.
RF5100	Problem is U7D or one of the destination IC's U5F, U7G, U7H, U8D, U9E, U14V. When repaired, refer to TTP RF1000.
RF5110	Is the signal PSEL (U7H-5) toggling? YES = RF5090 NO = RF5100
RF5120	If the failing signal is SCAN5 or SCAN6, problem is U8D or U8A. If the failing signal is SCAN0, SCAN2, SCAN4, or SCAN7, problem is U8D or U8B. If the failing signal is SCAN1 or SCAN3, problem is U8D or U8C. When failing IC is replaced, refer to TTP RF1000.

STATEMENT NUMBER

RF6100

The following guide should be used when troubleshooting the Data Extractors. The guide has been written for the parity channel. If troubleshooting a different channel, use the cross-reference chart located below or reference page 8 of schematic drawing 360103-309. Select Service Aid 23 for 25 ips operation.

CROSS REFERENCE CHART

	CHANNELS							
P	1	2	3	4	5	6	7	0
U12C-5	U12D-9	U12D-12	U12G-9	U12C-13	U12G-12	U12B-1	U12F-5	U12B-13
U11C-12	U11C-9	U12E-4	U11F-2	U11E-9	U12E-9	U11B-4	U11E-1	U11B-10
U13D-9	U13D-9	U13D-9	U13G-9	U13A-9	U13G-9	U13A-9	U13G-9	U13A-9
U8A-13	U8C-9	U8B-5	U8C-11	U8B-11	U8A-3	U8A-5	U8B-9	U8B-3
U13D-6	U13D-4	U13D-3	U13G-4	U13A-3	U13G-3	U13A-4	U13G-6	U13A-6
U13E-13	U13E-3	U13F-13	U13F-3	U13C-3	U13H-13	U13B-13	U13H-3	U13B-3
TP 30	TP 32	TP 28	TP 29	TP 34	TP 33	TP 31	TP 35	TP 27
U9E	U10G	U10G	U10G	U10G	U10G	U10G	U10G	U10G
U13E-9	U13E-7	U13F-9	U13F-7	U13C-7	U13H-9	U13B-9	U13H-7	U13B-7
U13D-10	U13D-12	U13D-15	U13G-12	U13A-15	U13G-15	U13A-12	U13G-10	U13A-10
U6A-9	U7B-9	U7A-7	U13C-9	U6B-7	U7A-9	U6A-7	U6B-9	U7B-7
U12C-6	U12D-8	U12D-11	U12G-8	U12C-11	U12G-11	U12B-3	U12F-6	U12B-11
U11C-11	U11C-8	U12C-6	U11F-3	U11E-8	U12E-8	U11B-6	U11E-3	U11B-8
U9C	U10C	U9D	U11D	U10E	U9A	U9B	U10D	U10B
U9C-15	U10C-15	U9D-15	U11D-15	U10E-15	U9A-15	U9B-15	U10D-15	U10B-15
U11C-3	U11C-6	U12E-3	U11F-6	U11E-6	U12E-11	U11B-3	U11E-11	U11B-11
U8C-12	U8C-4	U8C-6	U8A-10	U8A-8	U8A-2	U8B-12	U8C-2	U8B-2
U6A-13	U7B-13	U7A-3	U13C-13	U6B-3	U7A-13	U6A-3	U6B-13	U7B-3
U6A-9	U7B-9	U7A-7	U13C-9	U6B-7	U7A-9	U6A-7	U6B-9	U7B-7
U8A	U8C	U8B	U8C	U8B	U8A	U8A	U8B	U8B

STATEMENT NUMBER		
RF6110	Is the signal FWD (U12C-5) toggling?	
	YES = RF6120	NO = RF2100
RF6120	Is the signal PENAB* (U11C-12) toggling?	
	YES = RF6130	NO = RF2300
RF6130	Is the signal PECLK (U13D-9) toggling?	
	YES = RF6140	NO = RF2000
RF6140	Is the signal SCANP (U8A-13) toggling?	
	YES = RF6150	NO = RF5000
RF6150	Are the signals RDATAP (U13D-6) and RDROPP* (U13E-13) both toggling?	
	YES = RF6160	NO = RF4020
RF6160	Is the signal CHDROPP (TP 30) toggling?	
	YES = RF6180	NO = RF6170
RF6170	Problem is U13E or U9E. When repaired, refer to TTP RF1000.	
RF6180	Is the signal at U13D-10 toggling?	
	YES = RF6200	NO = RF6190
RF6190	Problem is U13D or U12C. When repaired, refer to TTP RF1000.	
RF6200	Is the signal DATAP (U12C-6) toggling?	
	YES = RF6220	NO = RF6210
RF6210	Problem is U12C, U9C, or U9E. When repaired, refer to TTP RF1000.	
RF6220	Is the signal at U11C-11 toggling?	
	YES = RF6240	NO = RF6230
RF6230	Problem is U12C, U11C, or U9C. When repaired, refer to TTP RF1000.	
RF6240	Is the signal at U9C-15 toggling?	
	YES = RF6260	NO = RF6250

STATEMENT NUMBER	
RF6250	Problem is U9C, U8C, U11C, or U6A. When repaired, refer to TTP RF1000.
RF6260	Is the signal at U6A-13 toggling? YES = RF6280 NO = RF6270
RF6270	Problem is U11C, U6A, or U9C. When repaired, refer to TTP RF1000.
RF6280	Is the signal DAVLP (U6A-9) toggling? YES = RF6300 NO = RF6290
RF6290	Problem is U6A or U8A. When repaired, refer to TTP RF1000.
RF6300	The data extractors are working correctly. Return to the TTP that sent you here.
RF7100	In this section the read multiplexer circuitry will be checked. The read multiplexer logic is located on page 9 of schematic drawing 360103-309. Load the good tape and select Service Aid 23 for 25 ips operation. Are all eight DAVL signals a 45.0 $\pm$7.5 kHz clock? DAVL0, U7C-4 DAVL1, U7C-3 DAVL2, U7C-2 DAVL3, U7C-1 DAVL4, U7C-15 DAVL5, U7C-14 DAVL6, U7C-13 DAVL7, U7C-12 YES = RF7110 NO = RF7105
RF7105	Troubleshoot the failing channel starting at RF6100.
RF7110	Is the signal at U7C-5 toggling? YES = RF7140 NO = RF7120
RF7120	Are the signals at U7C-9, -10, and -11 all toggling? YES = RF7130 NO = RF5000
RF7130	Problem is U7C or U9E. When repaired and U7C-5 is toggling, refer to TTP RF1000.

STATEMENT NUMBER		
RF7140	Are all eight DATA signals toggling? To determine this, check the following locations:	
	DATA0, U10F-4 DATA2, U10F-2 DATA4, U10F-15 DATA6, U10F-13	DATA1, U10F-3 DATA3, U10F-1 DATA5, U10F-14 DATA7, U10F-12
	YES = RF7150	NO = RF7105
RF7150	Is the signal at U10F-5 toggling?	
	YES = RF7170	NO = RF7160
RF7160	Problem is U10F or U9E. When repaired and U10F-5 is toggling, refer to TTP RF1000.	
RF7170	Are all eight CHDROP signals toggling? To determine this, check the following locations:	
	CHDROP0, U10G-4 CHDROP2, U10G-2 CHDROP4, U10G-15 CHDROP6, U10G-13	CHDROP1, U10G-3 CHDROP3, U10G-1 CHDROP5, U10G-14 CHDROP7, U10G-12
	YES = RF7180	NO = RF7105
RF7180	Is U10G-5 toggling?	
	YES = RF7200	NO = RF7190
RF7190	Problem is U10G or U9E. When repaired and U10G-5 is toggling, refer to TTP RF1000.	
RF7200	Are the signals DAVLP (U9E-3) and DATAP (U9E-13) both a 45.0 $\pm$7.5 kHz clock?	
	YES = RF7201	NO = RF7105
RF7201	Is the signal at U9E-10 toggling?	
	YES = RF7210	NO = RF7105
RF7210	Is the signal PSEL (U9E-1) toggling?	
	YES = RF7220	NO = RF5000
RF7220	Is the signal CHDROPX (U9E-9) toggling?	
	YES = RF7240	NO = RF7230

STATEMENT NUMBER	
RF7230	Problem is U9E or one of the destination IC's U9G, U10V, U11F, or U11V. When repaired, refer to TTP RF1000.
RF7240	Is the signal DATAOX (U9E-12) toggling? YES = RF7260 NO = RF7250
RF7250	Problem is U9E or U9G. When repaired and U9E-12 is toggling, refer to TTP RF1000.
RF7260	Is the signal DAVLX (U9E-4) toggling? YES = RF7280 NO = RF7270
RF7270	Problem is U9E or U9G. When repaired and U9E-4 is toggling, refer to TTP RF1000.
RF7280	The read multiplexers are working correctly; return to the troubleshooting routine that sent you here.
RF7300	In this TTP the skew buffer circuitry will be checked. The skew buffer logic is located on page 9 of schematic drawing 360103-309. Because of the complexities to effectively troubleshoot the skew buffer, a logic analyzer must be used. However, due to the unavailability of a logic analyzer, the following procedure provides a recommended sequence to replace the IC's used in the skew buffer without troubleshooting the circuit. Replace U9G and U7G. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7310
RF7310	Replace U9F, U8F, U8E, and U7F. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7320
RF7320	Replace U6F and U6G. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7330
RF7330	If the failure still occurs, we are unable to determine the cause. Return to the troubleshooting routine that sent you here.

STATEMENT NUMBER	
RF7500	In this section the error detect and postamble checking circuitry will be checked. This logic is located on page 9 of schematic drawing 360103-309. Load a scratch tape that is write-enabled. Using a jumper wire, ground U12W-5, then select Service Aid 23 for 25 ips operation. Is the signal STRBX (U17T -12) toggling? YES = RF7510 NO = RF7600
RF7510	Is the signal DCLK (U5F-8) toggling? YES = RF7520 NO = RF7620
RF7520	Is the signal CDATX (U11F-8) toggling? YES = RF7530 NO = RF7640
RF7530	Is the signal DROP1 (U9V-13) toggling? YES = RF7540 NO = RF7660
RF7540	Is the signal at U9V-10 toggling? YES = RF7550 NO = RF7670
RF7550	Is the signal FERR (U1J-3) toggling? YES = RF7560 NO = RF7680
RF7560	Are the signals at U18T-12 and U18T-13 toggling? YES = RF7570 NO = RF7690
RF7570	Is the signal at U18T-11 always high? YES = RF7580 NO = RF7700
RF7580	Is the signal at U10V-11 toggling? YES = RF7590 NO = RF7720
RF7590	The error detect and postamble checking circuitry are working correctly. Return to troubleshooting routine that sent you here.
RF7600	Is the signal POSTCHR (U10V-2) and PSEL (U10V-1) toggling? YES = RF7610 NO = RF7300

STATEMENT NUMBER	
RF7610	Problem is U10V, U11V, U17T, or one of the destination IC's U12V, U1J, U14V, U15V, U2J, or U17W. When repaired, refer to TTP RF1000.
RF7620	Is the signal DOUT (U5F-10) toggling? YES = RF7630 NO = RF7300
RF7630	Problem is U5F, U3J, or one of the destination IC's U19X, U19W, or U17W. When repaired and U5F-8 is toggling, refer to TTP RF1000.
RF7640	Is the signal at U11F-9 toggling? YES = RF7650 NO = RF7300
RF7650	Problem is U11F, U19V, or U19X. When repaired and U11F-8 is toggling, refer to TTP RF1000.
RF7660	Is CHDROPX (U10V-13) toggling? YES = RF7670 NO = RF7100
RF7670	Problem is U11V, U12V, U10V, U9V, or U3J. When repaired, refer to TTP RF1000.
RF7680	Problem is U1J, U2J, or U3J. When repaired, refer to TTP RF1000.
RF7690	Is the signal U15V-1 toggling? YES = RF7700 NO = RF7710
RF7700	Problem is U14V, U15V, U13V, U18T, or U17T. When repaired, refer to TTP RF1000.
RF7710	Problem is U12V, U14V, U15V, or U1J. When repaired, refer to TTP RF1000.
RF7720	Problem is U10V, U11V, U12V. When repaired, refer to TTP RF1000.

SECTION IV

MAINTENANCE

GENERAL

4-1. This section contains periodic maintenance information and adjustment procedures. Table 4-1 presents the preventive maintenance schedule.

MTSU POSITIONS FOR SERVICING

CAUTION

When MTSU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of MTSU in extended position could upset an inadequately anchored equipment rack.

4-2. **Operator Maintenance Access (See Figure 4-1).** To gain access to the tape path area for routine cleaning, proceed as follows:

a. Switch MTSU power off.

b. Withdraw drive on its slides until locks engage.

c. Open top cover by lifting sides directly behind front panel. Place cover stay in slot provided.

d. Perform required maintenance.

e. To return drive to operating position, close top cover.

f. Release slide locks and push unit back into equipment rack.

g. Switch MSTU power on.

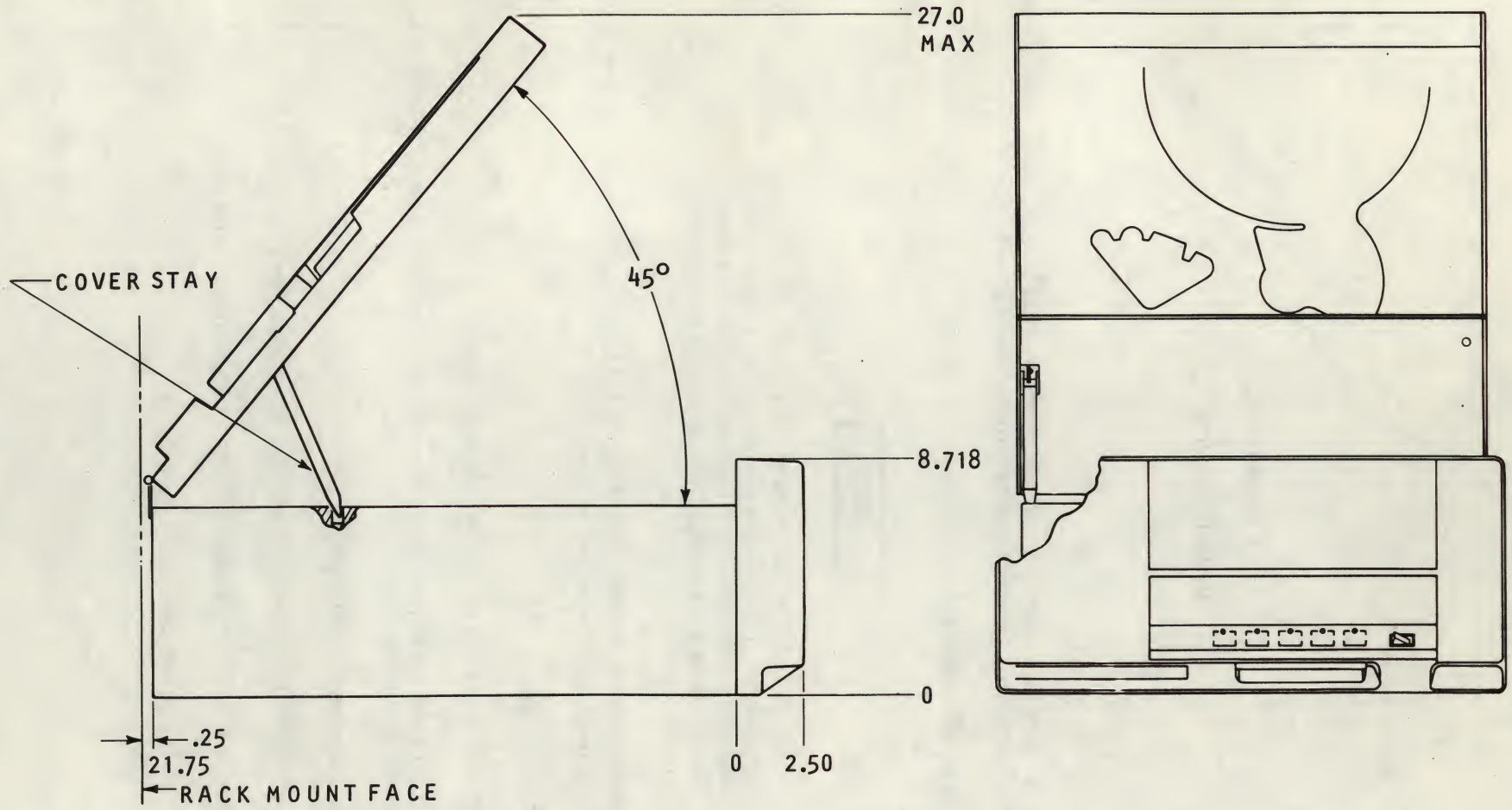

Figure 4-1. Operator Maintenance Access Position

4-3. **Service Access (See Figure 4-2).** To gain access to the main PWB and other internal components, proceed as follows:

a. Switch MTSU power off.

b. Place drive in operator maintenance access position. (Refer to paragraph 4-2).

c. Using a screwdriver, loosen two captive screws located at front sides of top plate casting.

d. Close top cover.

e. Grasping two lower corners of front panel, lift front panel to its maximum upright position. Lower slowly (about one inch) until the top plate support latch engages.

f. Insert the safety pin provided through both holes in the top plate support.

g. Perform required maintenance.

h. To return drive to operating position, remove the safety pin.

i. Lift front panel to its maximum upright position and lower smoothly to horizontal position.

j. Reverse steps a through d.

OPERATOR PREVENTIVE MAINTENANCE

4-4. For routine cleaning, place the MTSU in the operator maintenance access position. Figure 4-3 identifies by number the locations of items that require routine cleaning. The recommended cleaning materials are:

a. Tape Path Cleaner (Trichlorotrifluoroethane)

b. Head Cleaner (1,1,1-Trichloroethane)

c. Cotton Swabs

d. Plastic Cleaner - (Miller Stephenson Chemical Co., MS260, Windex, or equivalent commercial grade plastic cleaner).

e. Lint-Free, Non-Abrasive Wipes

NOTE

Items a through c are available as Cipher Part No. 131044-001, Tape Drive Cleaning Kit.

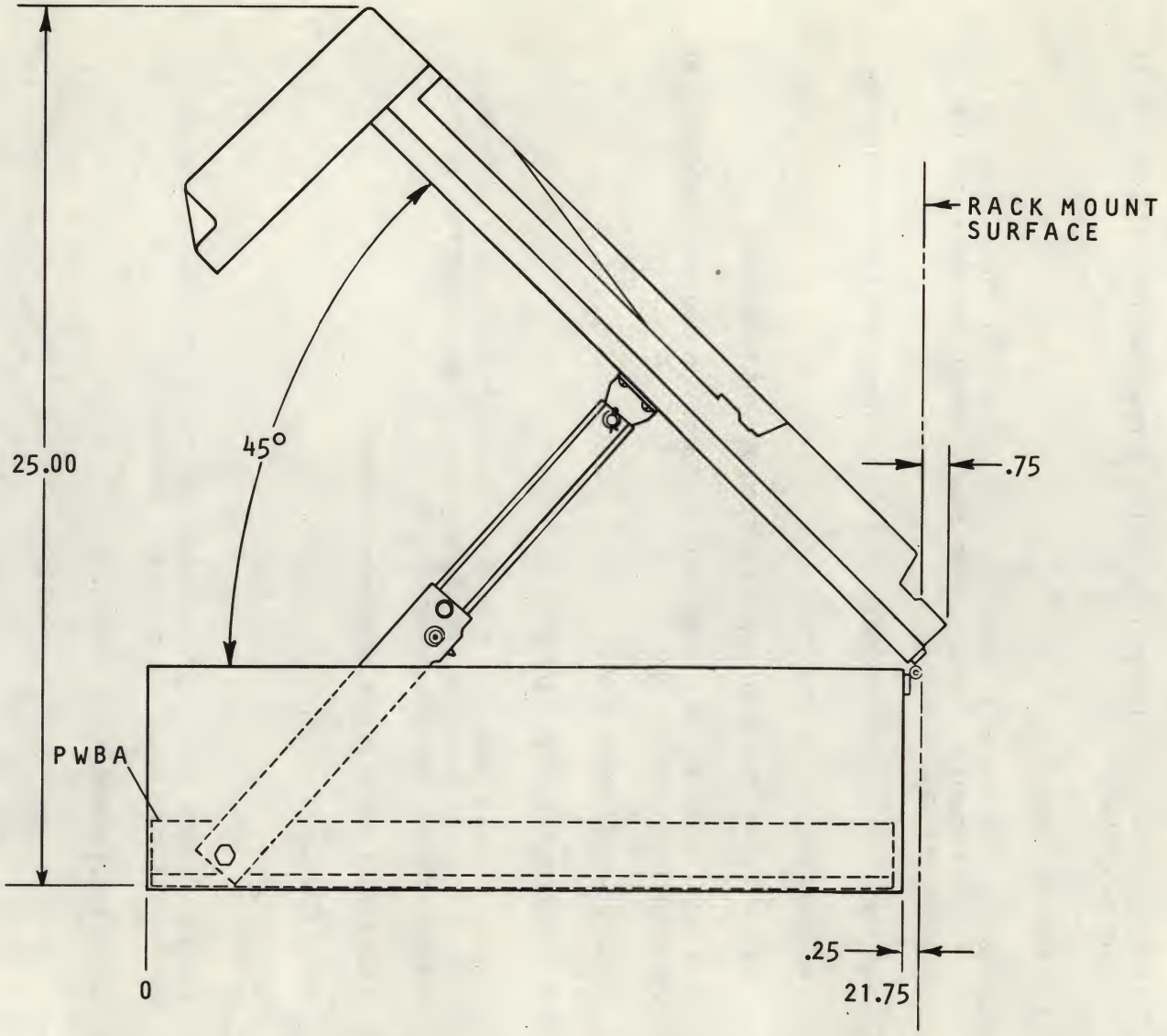

Figure 4-2. Service Access Position

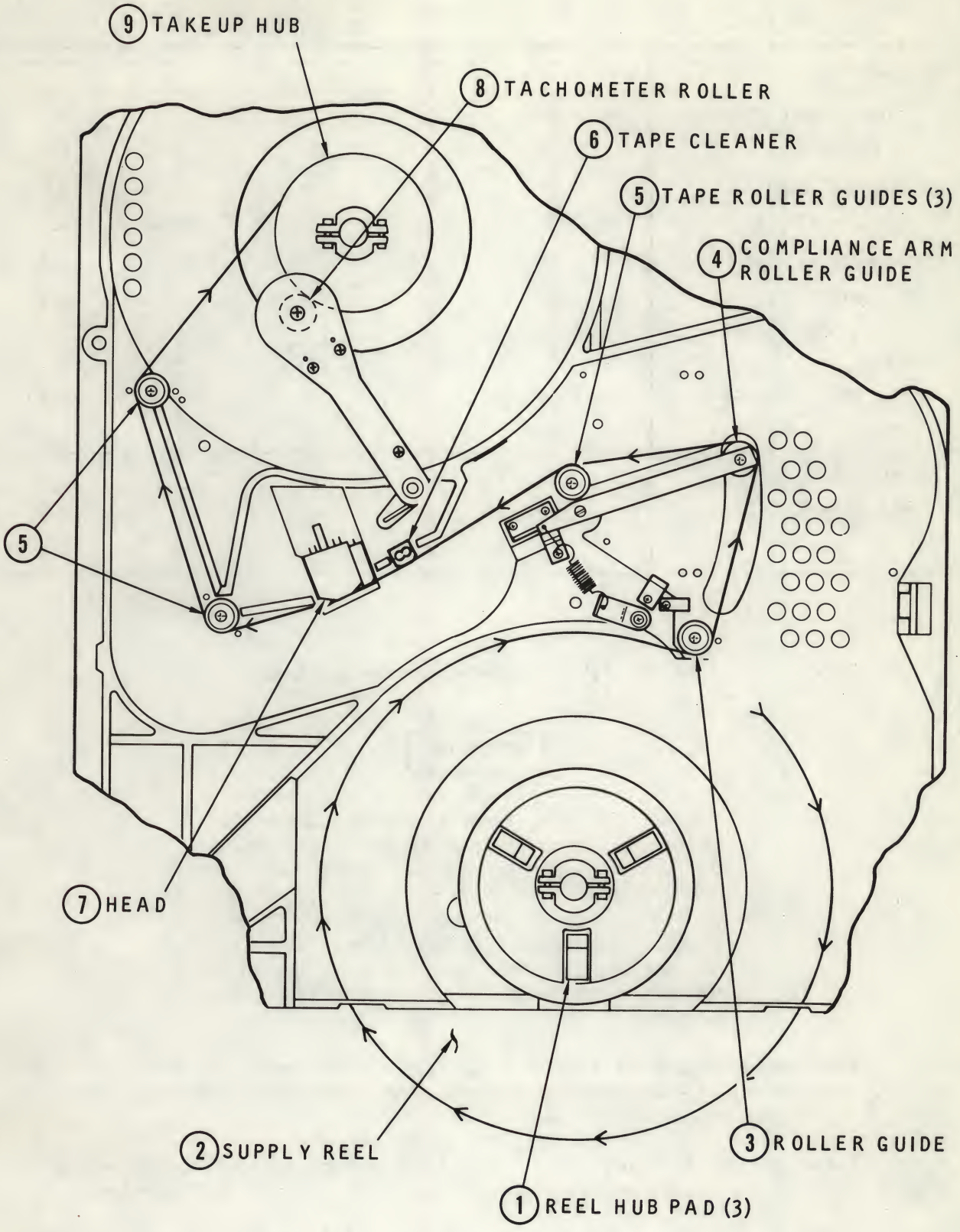

Figure 4-3. Tape Path and Related Parts

MAINTENANCE OPERATION	FREQUENCY (HOURS)	QUANTITY TO MAINTAIN	PROCEDURE PARAGRAPH
Operator			
Tachometer Roller	8	1	4-5
Take Up Hub	8	1	4-6
Roller Guides	8	5	4-7
Reel Hub Pads	8	3	4-8
Head	8	1	4-9
Tape Cleaner	8	1	4-10
Front Panel and Door	As Required	1	4-11
Top Plate Casting	As Required	1	4-12
Filter	1000	1	4-13
Service Technician			
Replace Reel Motors	5000	2	4-40 4-44

Table 4-1. Preventive Maintenance Schedule

CAUTION

Do not apply a cleaner directly from the container to the surface to be cleaned, even though instructions on the container may indicate to do so. Always apply the cleaner to a swab or wipe first, carefully removing any excess. The tachometer roller and roller guides contain precision bearings. Solvents allowed to run into the bearings will break down the lubricant.

4-5. **Tachometer Roller (8, Figure 4-3).** Use a swab moistened with tape path cleaner. Gently wipe the entire roller surface. The roller can be rotated by manually turning the take-up hub slowly.

4-6. **Take-Up Hub (9, Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Rotate the hub manually while gently wiping the tape wrapping surface.

4-7. **Roller Guides (3, 4 and 5, Figure 4-3).** Use a swab moistened with tape path cleaner. Rotate each roller and gently wipe the tape contact surface and flanges or washers.

4-8. **Reel Hub Pads (1, Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Wipe the contact surface of each pad and remove any debris around the pad.

4-9. **Head (7, Figure 4-3).** Use a swab or wipe moistened with head cleaner. Wipe the entire face of the head and attached erase bar, paying particular attention to the recessed areas.

CAUTION

Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors.

4-10. **Tape Cleaner (6, Figure 4-3).** Use a swab moistened with head cleaner. Wipe each blade along its length. Remove accumulated oxides from the recessed area between the blades.

CAUTION

Exercise care to avoid damage to sharp edges of tape cleaner blades.

4-11. **Front Panel and Door.** Use a wipe moistened with plastic cleaner.

4-12. **Top Plate Casting.** Use a wipe moistened with plastic cleaner. Referring to Figure 4-3, wipe away the oxide dust in the tape path area. Be careful not to get dirt on the head, rollers, etc. Avoid disturbing the sensors.

4-13. **Filter.** Locate and remove the filter from inside the air duct opening at the lower left of the front panel. See Figure 4-4. Clean the filter with low pressure compressed air, or vacuum, in the opposite direction of airflow and reinstall.

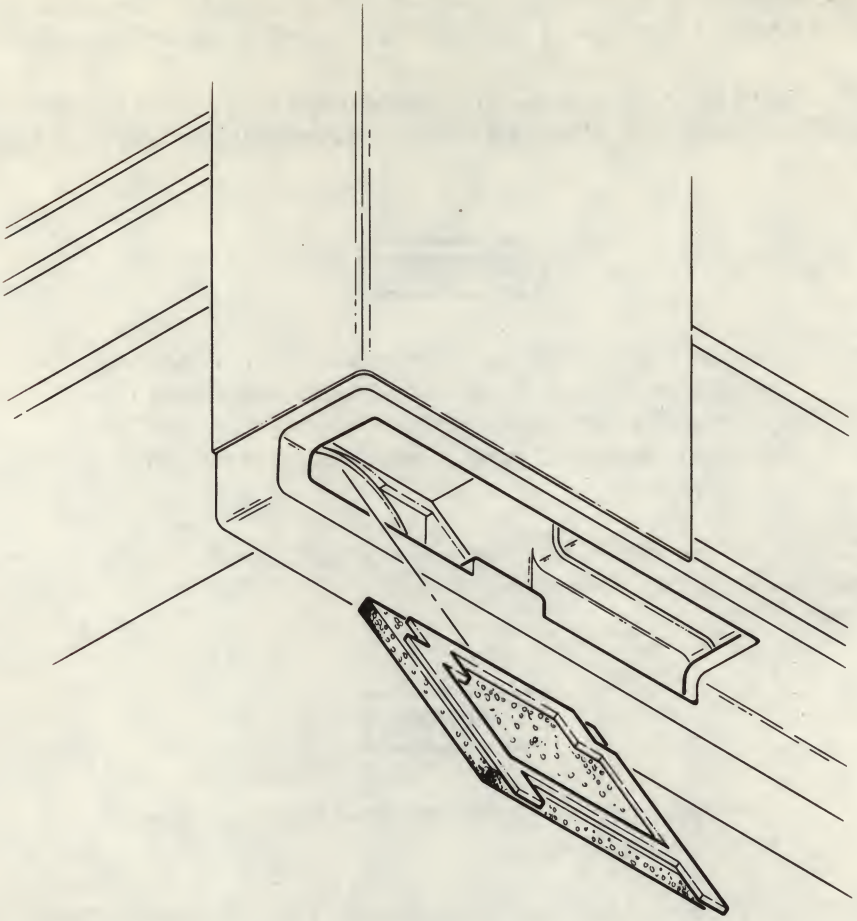

Figure 4-4. Air Filter Removal

SERVICE TECHNICIAN PREVENTIVE MAINTENANCE

4-14. **Reel Motors.** Replace both reel motors after 5000 hours of unit operation. Refer to paragraphs 4-40 and 4-44 for removal/replacement instructions.

4-15. **Fuse Removal and Replacement.** To replace the fuse, proceed as follows:

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

a. Remove power cord from outlet.

b. Place the drive in service access position. Refer to paragrpah 4-3.

c. Locate fuse cap on power supply housing. Push and twist cap to remove.

d. For 100-120 volt operation, use a 3-ampere, slo-blo, 250V type fuse.

e. For 208-240 volt operation, use a 1-1/2 ampere, slo-blo, 250V type fuse.

f. Reverse steps a through c.

4-16. **Read Threshold Adjustment.** Adjustment of the read threshold level is required only when the head or main PWB is changed. Adjust read threshold as follows:

a. Place drive in service access position. Refer to paragraph 4-3.

b. Apply power to unit.

c. Load tape (write-enable ring must be installed).

NOTE

Use a National Bureau of Standards Reference Level Tape, or a certified tape that produces comparable read levels when compared with a National Bureau of Standards tape for this adjustment.

d. Activate Service Aid 21. Refer to paragraphs 3-3 and 3-26.

e. Shield the LED indicators on the front panel from ambient light so that an accurate indication of ON, OFF or FLASHING can be observed.

f. Note the indication of the front panel LED's before attempting any adjustment.

g. If LOAD and UNLOAD indicators flash intermittently, NO ADJUSTMENT IS REQUIRED. Refer to step i.

h. If the LOAD and UNLOAD indicators are not flashing intermittently, adjust R115 for the indication in step g. R115 may require several turns (in either direction) to find the correct adjustment point. If the correct adjustment point cannot be found, a fault in (a) effecting the adjustment, (b) the head assembly, or (c) main PWB is indicated.

i. Exit Service Aid 21.

NOTE

This adjustment is based on the amplitude characteristics of the tape used for the adjustment. Other tapes whose amplitude characteristics are different may not provide the same indication after the adjustment. This fact simply reflects the difference in tapes and is not a fault condition. The tolerance range of the adjustment takes into account the inherent differences between tapes that otherwise meet the ANSI X 3.40-1976 criteria.

j. Reverse steps a through c.

REPAIR AND REPLACEMENT OF PARTS AND COMPONENTS

4-17. The MTSU is designed to operate over long periods of time without requiring corrective maintenance of any kind. Spare parts are available for replacement of parts and subassemblies which may have become damaged or worn through extremely long and/or hard usage. This section presents instructions for removal of defective parts and subassemblies from the transport and replacment with the parts available, as well as disassembly, assembly, and adjustment instructions where applicable.

4-18. Except as noted, subassemblies and parts which can be removed from above the top plate are indexed in Figure 4-5, while those which can be removed from beneath the top plate are indexed in Figure 4-6. Refer to the respective key lists of these figures for the names of the subassemblies and parts indexed on each. These lists also contain the figure numbers of the detail drawings, presented in this section, in which removal and/or disassembly of these subassemblies and parts are illustrated.

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

FRONT PANEL ASSEMBLY (1, Figure 4-5).

4-19. **Power Switch Replacement.** To replace the power switch (1, Figure 4-7) proceed as follows:

a. Remove power cord from outlet.

b. Position transport in service access position in accordance with instructions in paragraph 4-3.

c. Remove wire connectors from terminals of power switch in back of front panel, identifying each terminal as to the switch terminal from which it was removed.

d. Bend in tabs holding switch to panel, and push out of panel from back.

e. Place replacement switch in front panel, bend tabs in back of switch as necessary to fit tightly in panel, and reconnect wires as identified in step c.

f. Restore transport to operating position.

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-5	MODEL F880 TAPE TRANSPORT (Top View)	REF	
-1	FRONT PANEL ASSEMBLY	4-7	4-21
-2	SUPPLY HUB ASSEMBLY	4-8	4-23
-3	HEAD ASSEMBLY.....	4-10	4-24
-4	ROLLER GUIDE ASSEMBLY.....	4-11	4-25
-5	EOT/BOT SENSOR ASSEMBLY.....	4-12	4-26
-6	TACHOMETER ASSEMBLY.....	4-13	4-27
-7	COVER ASSEMBLY	4-14	4-28
-8	TAKEUP HUB ASSEMBLY.....	4-15	4-29
-9	COMPLIANCE ARM ASSEMBLY	4-17	4-30
-10	TAPE-IN-PATH SENSOR, TRANSMITTER	4-18	4-32
-11	TAPE-IN-PATH SENSOR, RECEIVER	4-19	4-33
-12	COMPLIANCE ARM BUMPER ASSEMBLY.....	4-20	4-34
-13	ROLLER TAPE GUIDE ASSEMBLY (Solid)	4-21	4-35
-14	FILE-PROTECT SENSOR.....	4-22	4-36

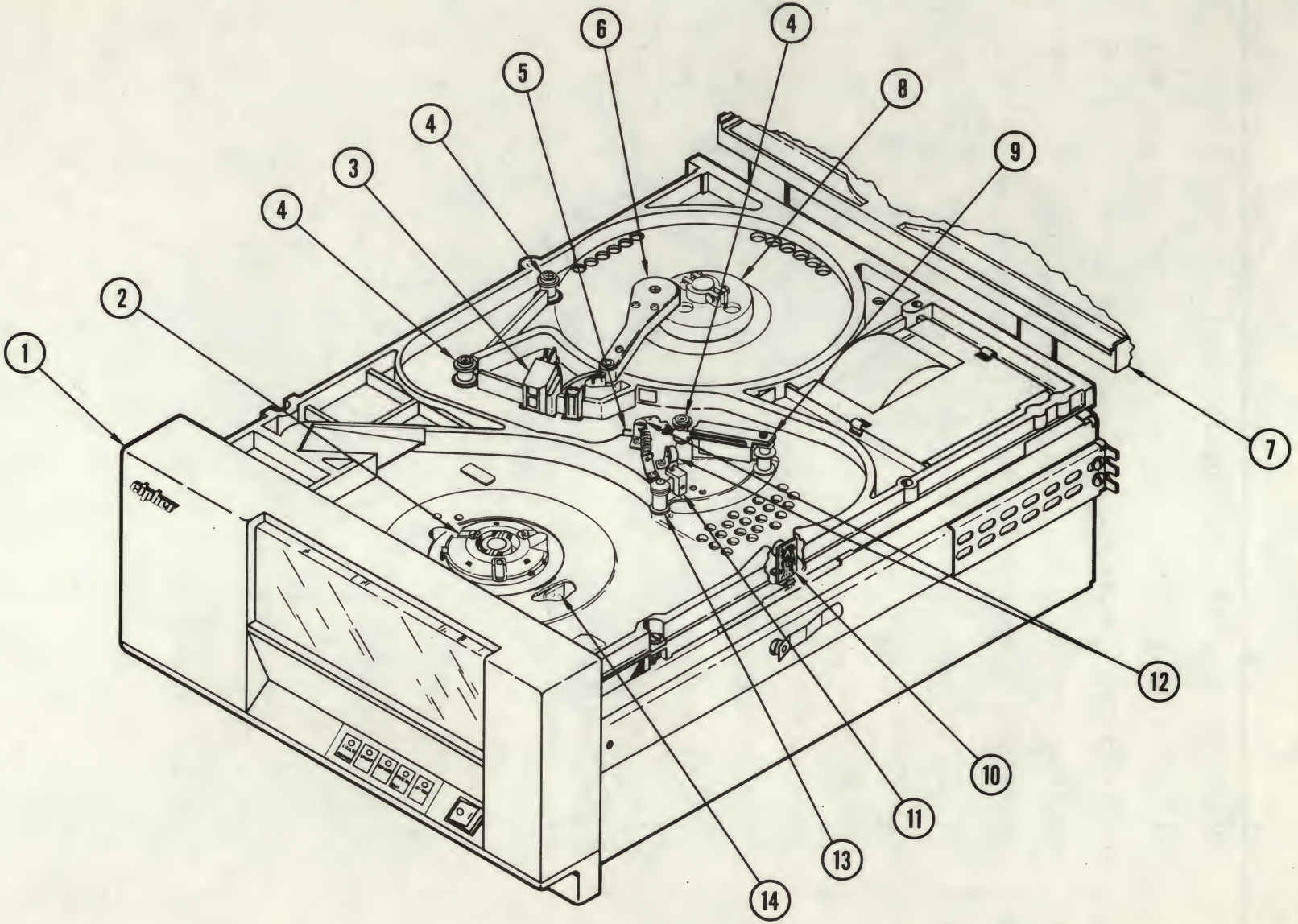

Figure 4-5. Model F880 Tape Transport (Top View)

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-6	MODEL F880 TAPE TRANSPORT (Bottom View) ..	REF	
-1	DRIVE MAIN PWB ASSEMBLY	4-23	4-37
-2	POWER SUPPLY ASSEMBLY	4-24	4-38
-3	POWER SUPPLY PWB	4-25	4-39
-4	TAKEUP MOTOR ASSEMBLY.....	4-26	4-40
-5	AIR DUCT, top-plate	4-27	4-41
-6	AIR DUCT, front panel	4-27	4-42
-7	TUBE, air intake	4-27	4-41
-8	SUPPLY MOTOR ASSEMBLY	4-28	4-44
-9	AIR CAPACITOR ASSEMBLY.....	4-17	4-30
-10	HUB LOCK ASSEMBLY	4-29	4-45
-11	DOOR LOCK ASSEMBLY	4-30	4-48
-12	TRANSFORMER ASSEMBLY	4-31	4-49

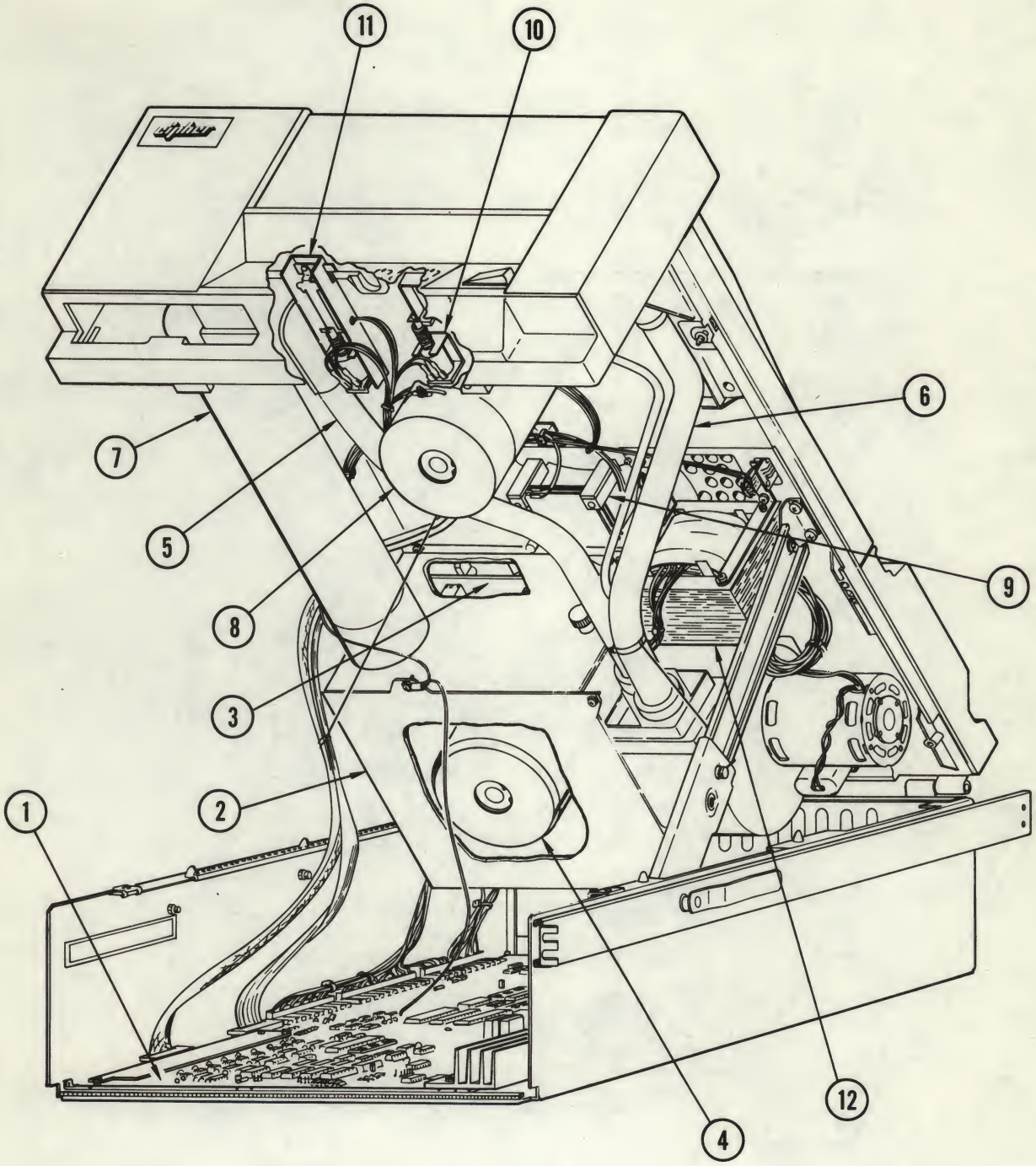

Figure 4-6. Model F880 Tape Transport (Bottom View)

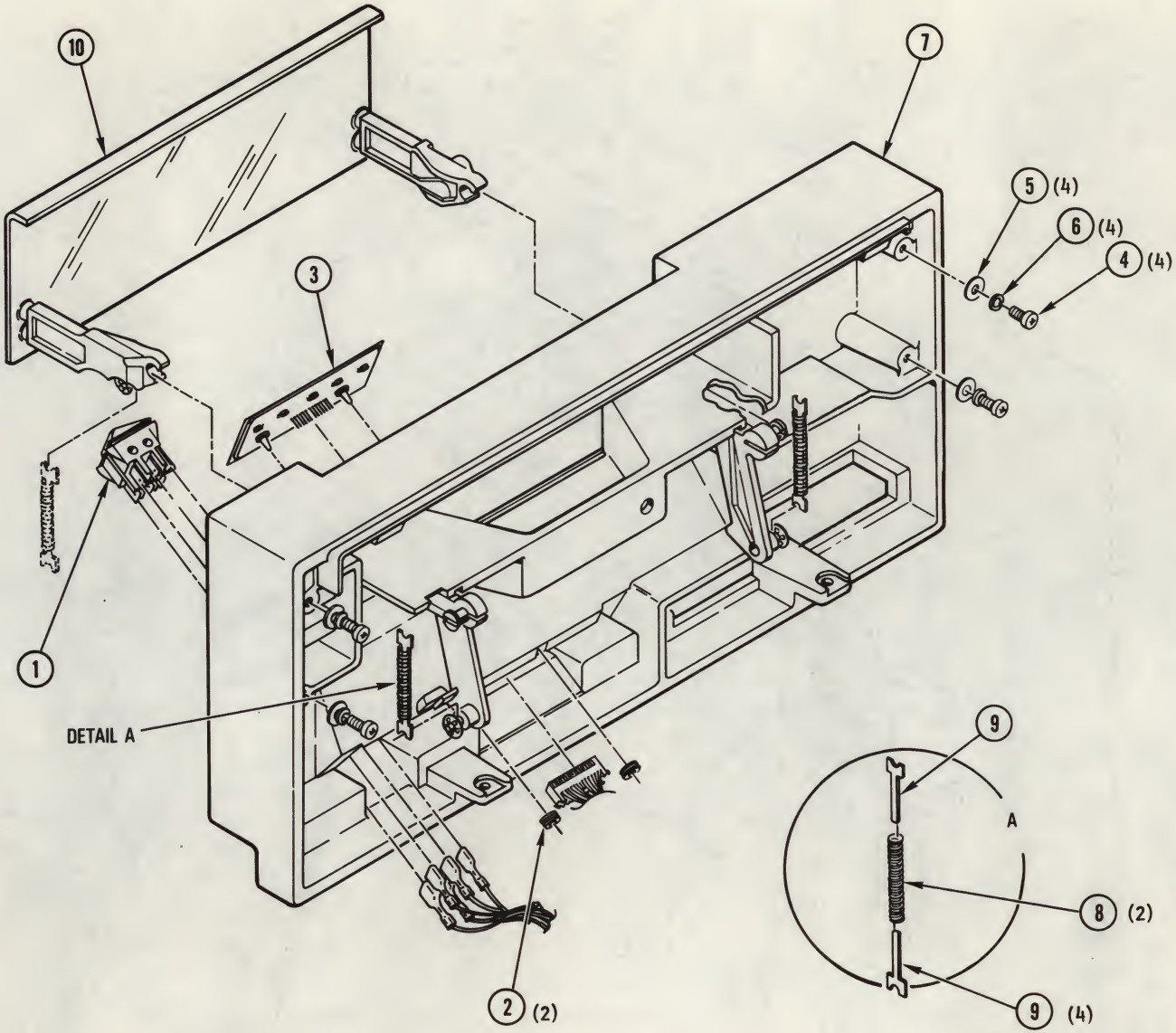

Figure 4-7. Front Panel Assembly

4-20. **Touch Switch Replacement.** To replace the touch switch (3, Figure 4-7), proceed as follows:

a. Position transport in service access position, in accordance with instructions in paragraph 4-3.

b. Remove connector from switch in back of front panel, noting position of connector.

c. Remove grommets (2) from attachment posts of switch (3) and lift switch out of front panel.

d. Insert replacement switch in front panel, place grommets (2) on attachment posts, pressing down tightly against panel, and secure using Permabond.

e. Attach switch connector at back in same position as removed in step b (brown wire nearest power switch).

f. Restore transport to operating position.

4-21. **Front Panel Subassembly Replacement.** To replace the front-panel subassembly (7, Figure 4-7), proceed as follows:

NOTE

For purposes of this procedure, it is assumed that power switch (1), touch switch (3), and door assembly (10) are to be removed from discarded front panel subassembly and reused in replacement. If one or more of these items is also to be replaced, disregard instructions for removal of such items in this paragraph.

a. Position transport in service access position, in accordance with instructions in paragraph 4-3.

b. Open front-panel door (10).

c. Remove four screws (4), lockwashers (5), and flat washers (6). Remove switch wire terminals and connectors attached to switches (1 and 3), noting position of each. Lift off entire front panel assembly.

NOTE

If air intake tube comes off with front panel, remove from front panel and set aside for reassembly.

d. Remove following parts and subassemblies from discarded front-panel subassembly (7) and replace in replacement front panel subassembly as follows:

(1) Power switch: refer to paragraph 4-19.

(2) Touch switch: refer to paragraph 4-20.

(3) Door assembly: refer to paragraph 4-22.

e. If air intake tube came off with front panel replace in front panel.

f. Attach complete front panel assembly to top plate with screws, washers, and lockwashers removed in step c. Ensure that gooseneck of front panel air duct is properly positioned (paragraph 4-42, step f).

g. Reconnect wires and connectors as identified in step c.

h. Restore transport to operating position.

i. Use Service Aid 32 to test door lock adjustment. Refer to paragrpah 4-48, step j for adjustment procedure.

4-22. **Removal And Replacement of Door Assembly.** To replace the door assembly (10, Figure 4-7), proceed as follows:

a. Remove front panel assembly from top plate in accordance with paragraph 4-21, steps a, b, and c.

b. Remove two springs (8) and four guides (9), and push door out of front panel, using finger pressure on back of door from under side of panel.

c. Install door assembly in front panel subassembly by snapping arms onto plastic studs of front panel assembly, as indicated in Figure 4-7.

d. Assemble guides (9) with springs (8), with flat surfaces of guides in contact with each other.

e. Reinstall assembled front panel assembly on top plate in accordance with paragraph 4-21, steps e-i.

f. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

SUPPLY HUB ASSEMBLY (2, Figure 4-5).

4-23. **Removal, Replacement and Adjustment (Figure 4-8).** Place transport in operator maintenance access position in accordance with paragraph 4-2 and proceed as follows:

a. Rotate hub assembly (1, Figure 4-8) so that socket-head screws face front panel door.

b. Open front-panel door and loosen socket-head screws (2).

c. Remove supply hub from reel motor shaft.

d. Install replacement hub on shaft, and position hub height gauge, Cipher Part No. 760105-545, as shown in Figure 4-9 so that it contacts the raised machined surface of the top plate. Raise the supply hub until the reference surface contacts the hub-height tool.

e. Ensuring that hub-height tool is in contact with both the top plate and reel hub, tighten socket-head screws (2).

f. Remove tool, restore transport to operating position, and load tape.

g. Run tape forward and reverse using Service Aid 23, noting tape position on reel for which replacement hub was installed. If tape is centered between sides of reel, adjustment is correct. If not, loosen socket-head screws and repeat steps d through g until positioning is correct.

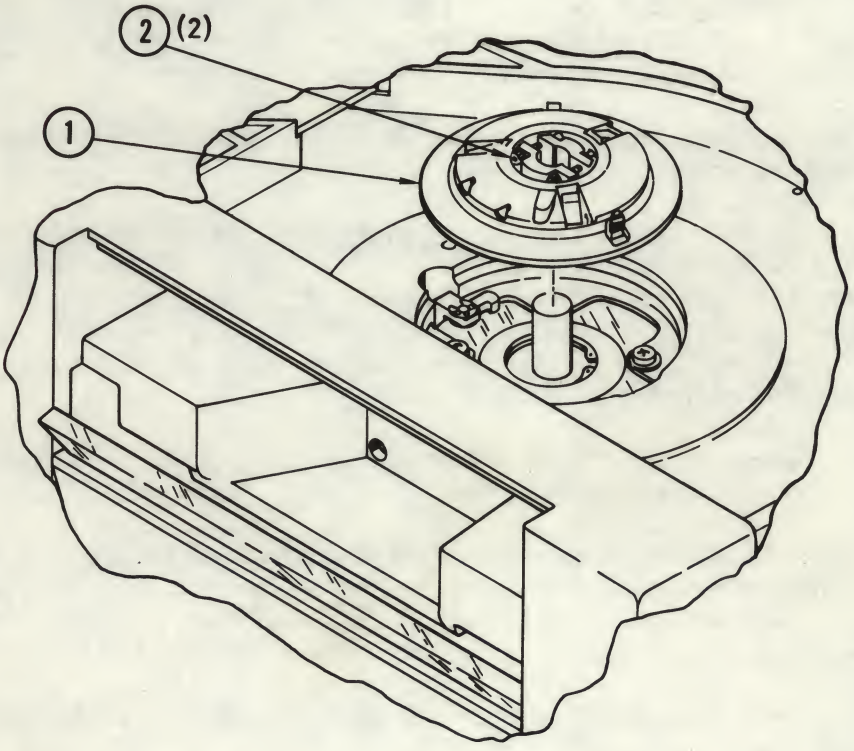

Figure 4-8. Supply Hub Assembly

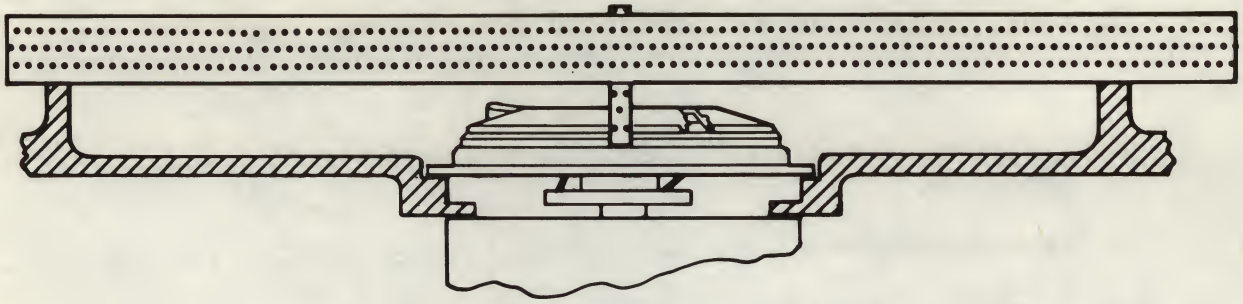

Figure 4-9. Supply Hub Adjustment

HEAD ASSEMBLY (3, Figure 4-5).

4-24. **Removal and Replacement of Assembly and Parts (Figure 4-10).** Place the transport in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

NOTE

It is not necessary to remove complete assembly from top plate in order to remove tape scraper (14, Figure 4-10). Refer to paragaph 4-24, f. If head is defective and in need of replacement, entire head assembly (9), including tape scraper (14) must be replaced.

a. Remove head connectors from P6/P7 on main PWB and remove from cable retractor.

b. Working from under side of top plate, remove center adjustment screw (1), lockwasher (2), flat washer (3), four screws (4), and lockwashers (5), three flat washers (6), one flat washer (7), and cable clamp (8) supporting assembly (9) with one hand as last screw is removed. Identify wire terminal and cable clamp as to position from which removed, and save attaching parts for reinstallation.

c. Pull assembly (9) and wire harness carefully down through hole in top plate and cables over air intake tube.

d. Install replacement assembly in reverse order of sequence in steps b and c, carefully pushing head and connectors through hole in top plate and attaching wire terminal and cable clamp in positions from which removed. Do not tighten center adjustment screw (1) at this time.

e. Feed head connectors and cables through cable retractor and over air intake tube and install on J6/J7 on main PWB.

f. If tape scraper (14) only is to be replaced, remove two socket-head screws (13), nuts (10), lockwashers (11), and flat washers (12). Save attaching parts for reassembly, and install replacement scraper in reverse order of removal.

g. Adjust tape scraper (14) as follows:

(1) Insert and load a tape.

(2) Loosen socket-head screws (13) and move tape scraper away from tape.

(3) Slowly move tape scraper toward tape until it contacts tape.

(4) Rotate tape scraper until both scraper blades are touching the tape, producing two vertical creases in the tape at the points of contact.

(5) Verify that tape is touching erase bar. Check for vertical crease in tape at the point of contact.

(6) Tighten socket-head screws (13) and reverify that tape is in contact with both blades of tape scraper and the erase bar.

h. Perform tape alignment procedure, paragraph 4-50.

i. Place transport in operating position.

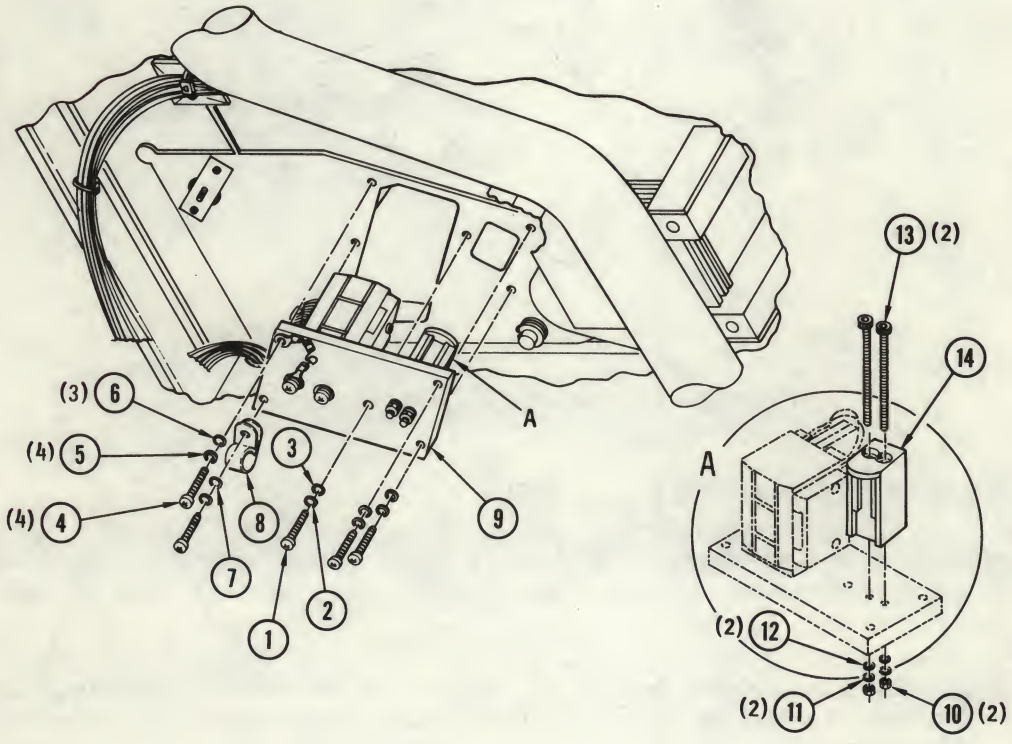

Figure 4-10. Head Assembly

ROLLER GUIDE ASSEMBLY (4, Figure 4-5).

4-25. **Removal and Replacement of Assembly (Figure 4-11).** Place the transport in operator maintenance access position in accordance with instructions in paragraph 4-2 and proceed as follows:

a. Remove attaching screw (1, Figure 4-11), leaving shims (4) and spring (3) in place, remove roller guide assembly through top of top plate, saving attaching parts for reassembly.

b. Install replacement roller guide (2), using original attaching parts.

c. Perform tape alignment procdure, paragraph 4-50.

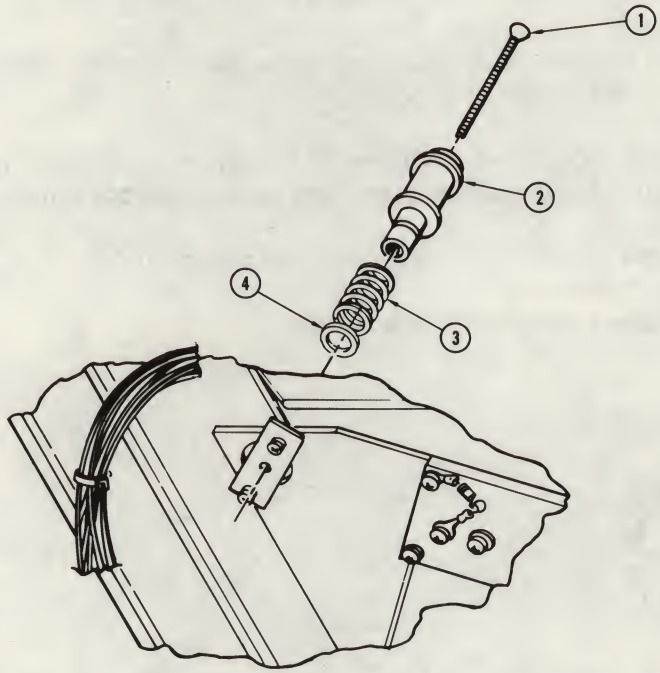

Figure 4-11. Roller Guide Assembly

EOT/BOT SENSOR ASSEMBLY (5, Figure 4-5).

4-26. **Removal and Replacement (Figure 4-12).** Place transport in operator maintenance access position, in accordance with paragraph 4-2, and proceed as follows:

a. Holding compliance arm aside to provide access to mounting screws, remove two screws (1, Figure 4-12) and lock washers (2) and retain for reassembly.

b. Remove EOT/BOT assembly (3), carefully pulling wires and connector (4) through hole in top plate assembly.

c. Unplug EOT/BOT assembly.

CAUTION

To prevent misalignment, avoid contact with sensors mounted on replacement EOT/BOT PWB. Sensors are factory-aligned for optimum output.

d. Attach plug removed in step c.

e. Feed wires and connector (4) carefully through hole in top plate assembly (refer to step b).

f. Attach EOT/BOT assembly loosely with screws (1) and lockwashers (2), position assembly as close to tape as mounting bracket will allow, with PWB parallel to casting wall directly behind it, and tighten screws.

g. Place transport in operating position.

h. Use Service Aids 22 and 23 to test EOT/BOT assembly.

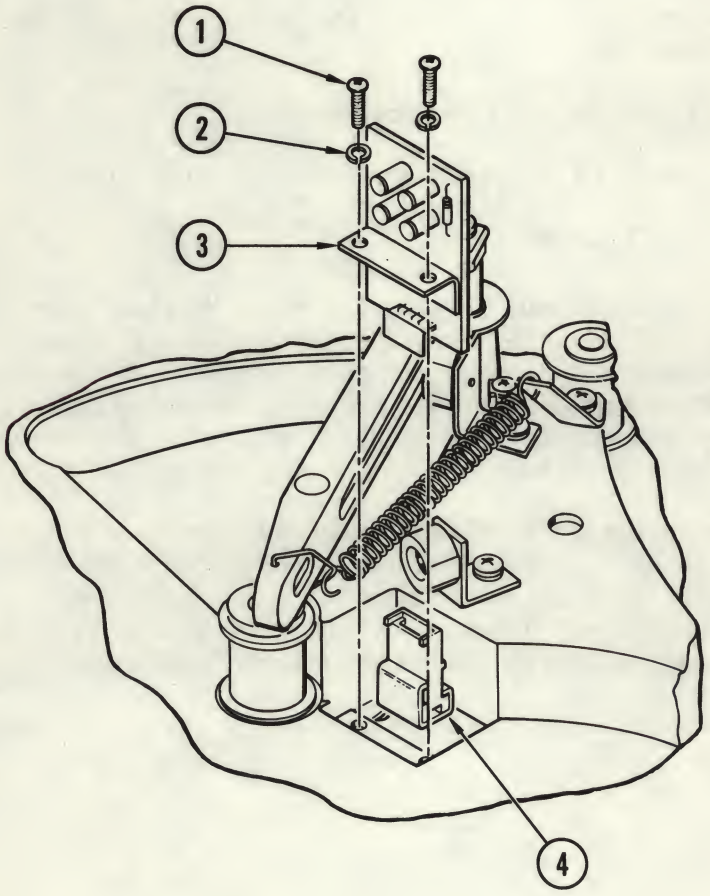

Figure 4-12. EOT/BOT Assembly

TACHOMETER ASSEMBLY (6, Figure 4-5).

4-27. **Removal and Replacement (Figure 4-13).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Disconnect tachometer wiring harness connector from mating connector beneath top plate.

b. Remove grip ring (1, Figure 4-13), wavespring washer (2), and shim(s) (3) from tachometer post beneath top plate and save for reassembly.

c. Remove tachometer assembly (6) from top plate, pulling wire harness and connector carefully through hole.

d. If lower bearing (4) or upper bearing (5) was removed, apply Loctite 601 sparingly to outside surface of replacement bearing before installing.

e. Install replacement tachometer assembly through upper bearing (5) and lower bearing (4), seating end of spring in adjacent small hole in top plate.

f. Install shim(s) (3), wavespring washer (2), and grip ring (1). If necessary, install additional shims (3) to compress wavespring half of its height when grip ring is installed.

g. Push connector and wire harness through top plate hole, and connect beneath top plate.

h. Place transport in operating position.

i. Use Service Aid 11 to test tachometer operation.

COVER ASSEMBLY (7, Figure 4-5).

4-28. **Removal and Replacement of Assembly and/or Parts (Figure 4-14).** Place the transport in operator maintenance access position (paragraph 4-2). Remove damaged cover assembly, subassemblies, and/or parts as necessary in the sequence of index numbers (Figure 4-14) assigned to the item and its attaching parts, saving attaching parts for use during reassembly if necessary, and install the replacement item in reverse sequence of removal. Observe the following special instructions:

a. When replacing catch (10) tighten screws just enough to hold and then try closing cover. If catch is too far forward and prevents cover from closing or is too far back to engage latch on front panel assembly, loosen attaching screws (7) and move catch forward or backward so that the cover closes and catch latches securely on front panel.

b. Restore transport to operating position.

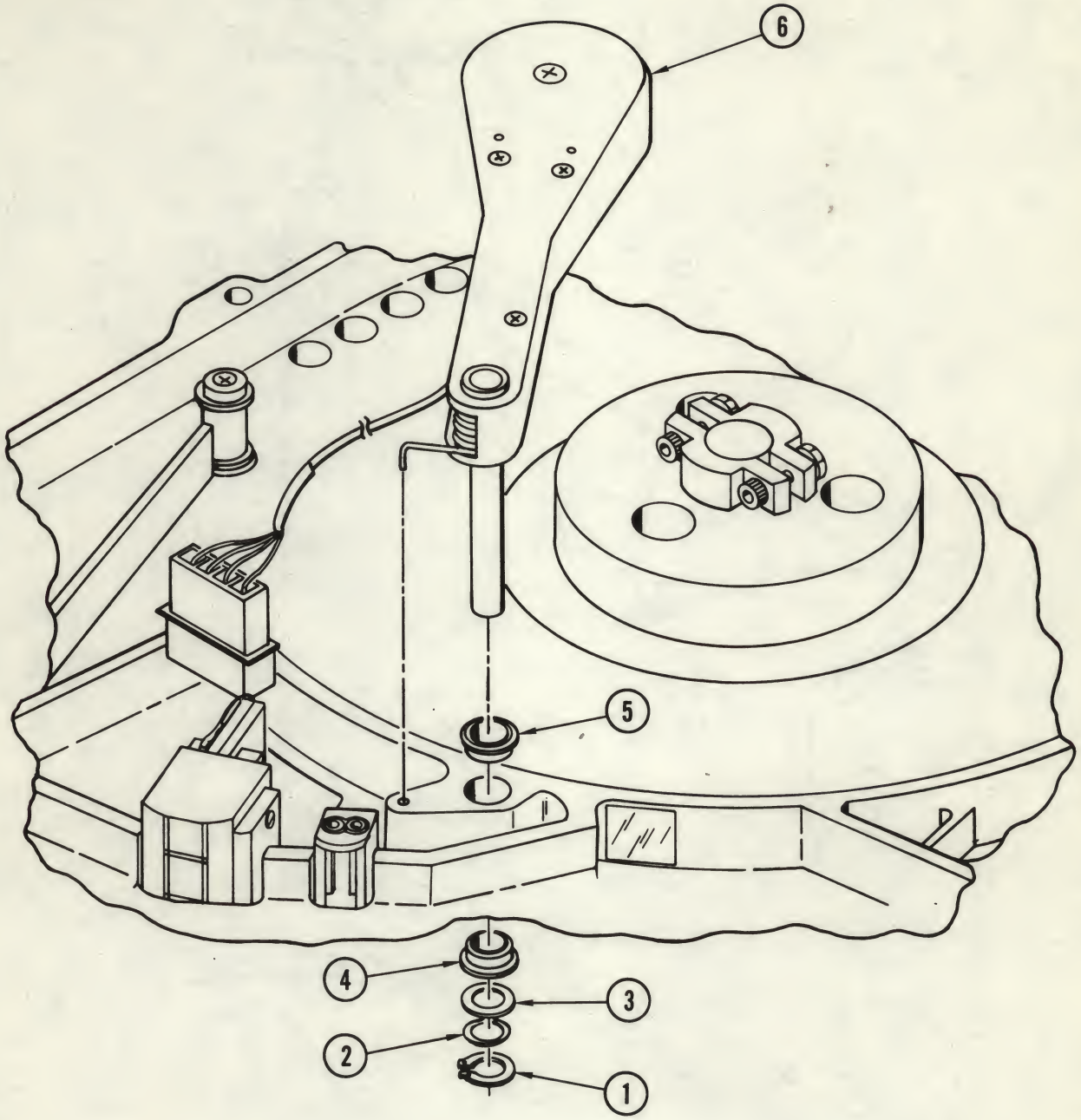

Figure 4-13. Tachometer Assembly

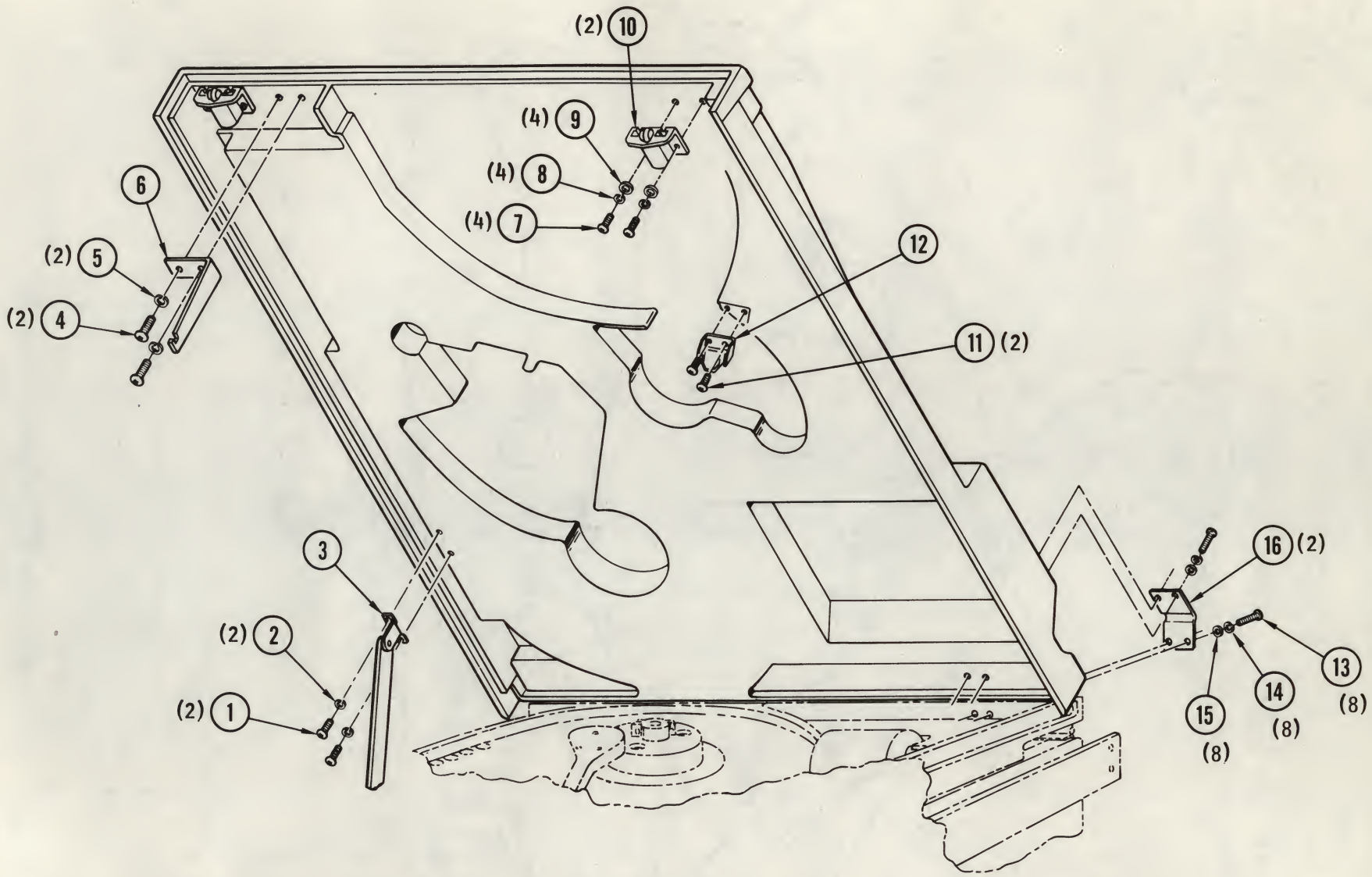

Figure 4-14. Top Cover Assembly

TAKEUP HUB ASSEMBLY (8, Figure 4-5).

4-29. **Removal, Replacement, and Adjustment (Figure 4-15).** Place the transport in operator maintenance access position in accordance with paragraph 4-2, and proceed as follows:

a. Secure tachometer assembly (1) away from the takeup hub.

b. Loosen socket-head screws (2, Figure 4-15) and remove hub (3).

c. Install replacement hub on shaft and position hub height gauge, Cipher part No. 760105-545, as shown in Figure 4-16.

d. Position hub on shaft so that hub height gauge is in contact with both the raised machined area of the top plate and takeup hub, and tighten socket-head screws (2).

e. Remove tool, carefully replace tachometer assembly against hub, restore transport to operating position, and load tape.

f. Run tape forward and reverse using Service Aid 23, noting tape position on replacement hub. If tape is centered on hub, adjustment is correct. If not, loosen socket-head screws (2) and repeat steps b through e.

g. Place transport in operating position.

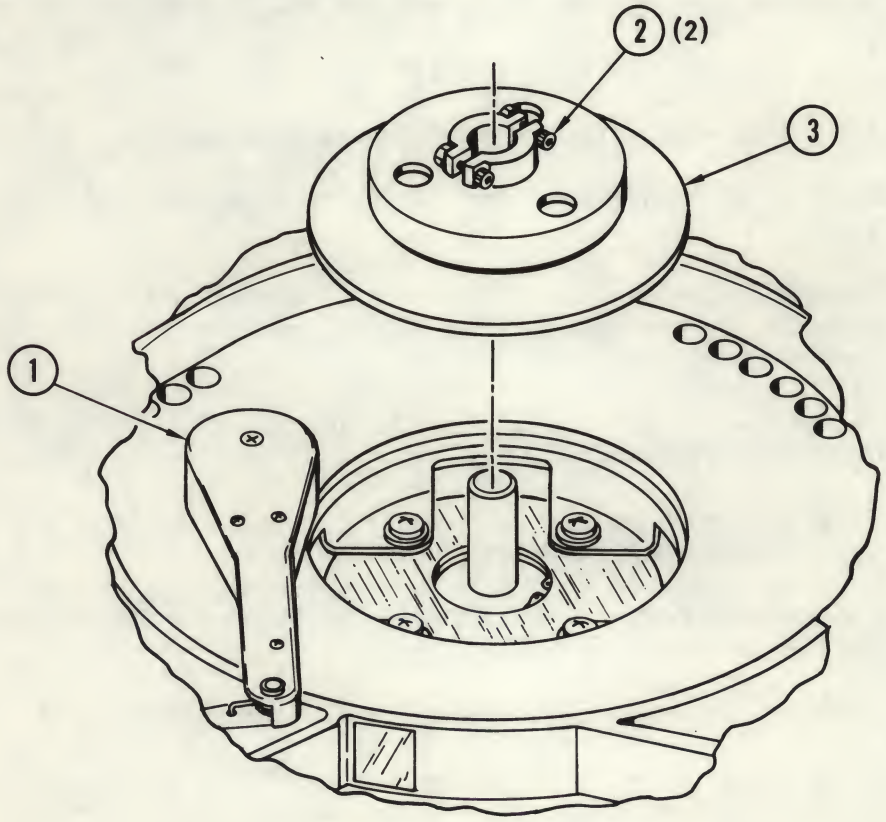

Figure 4-15. Takeup Hub

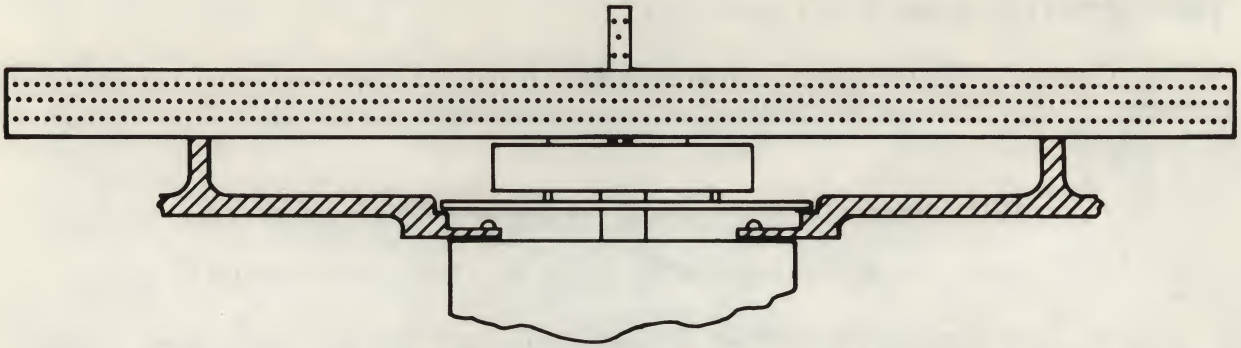

Figure 4-16. Takeup Hub Adjustment

COMPLIANCE ARM ASSEMBLY (9 Figure 4-5), AIR CAPACITOR ASSEMBLY (9, Figure 4-6).

NOTE

To facilitate removal of the compliance arm assembly, this procedure combines the removal, disassembly, assembly and installation of the compliance arm assembly with that of the air capacitor.

4-30. **Removal and Disassembly (Figure 4-17).** Place the transport in service access position in accordance wih instructions in paragraph 4-3. Proceed as follows:

NOTE

Save all attaching parts for use in reassembly.

a. Remove the top plate air duct. Refer to paragraph 4-41. Do not remove Ty-rap.

b. Remove two screws (1), lockwashers (2) and flat washers (3) attaching air capacitor shutter blade (4) to hub (5), and remove blade (4) from air capacitor stator (8).

c. Remove wire terminals clipped to air capacitor stator (6) plates and identify for reassembly.

d. Remove two allen-head screws (6) and one allen-head screw (7), and remove air capacitor stator (8) from top plate.

e. Loosen socket head screw (9) and remove shutter hub (5) from end of compliance arm shaft.

f. From top side of plate, remove spring (10) from bracket (11).

g. From bottom side of top plate, remove retaining ring (12), wavespring washer (13), and shim (14). Lift compliance arm assembly from top plate. Remove lower bearing (15) or upper bearing (16) only if it requires inspection and/or replacement. These bearings are attached to top plate with Loctite 601.

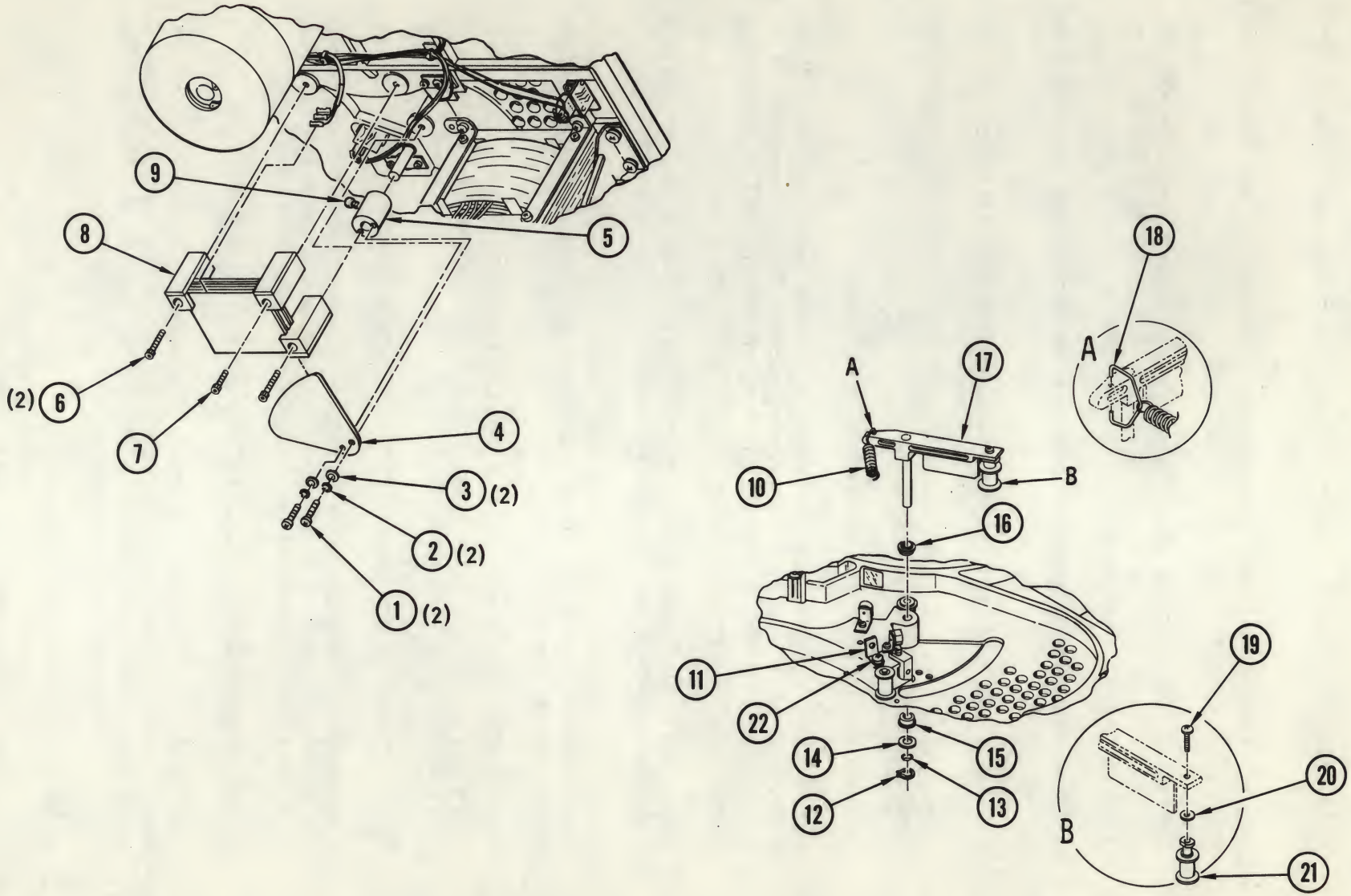

Figure 4-17. Compliance Arm and Air Capacitor Assemblies

h. Remove clip (18) from arm (17) by spreading ends out of hole in arm.

i. To remove tape guide (21), remove screw (19), and shim (20), saving shim for reassembly.

4-31. **Reassembly, Installation, and Adjustment.** Reassemble and install the compliance arm and air capacitor assemblies as follows:

a. Replace defective parts and reassemble compliance arm assembly as shown in Figure 4-17, in reverse order of steps g through i, paragraph 4-30, observing the following special instructions.

(1) Use attaching parts and shims saved from removal and disassembly as necessary.

(2) Apply Lubriplate to bearing surfaces between clip (17) and arm (18).

b. If bearing (15) or (16) was removed, apply small amount of Loctite 601 around outside of bearing and replace.

c. Install shaft carefully through bearings in top plate.

d. Install shim (14), wavespring washer (13), and retaining ring (12) on bottom of shaft. Check wavespring washer (13) to see that it is compressed half of its height. If not, add shims (14) as necessary, checking compliance arm for freedom of movement.

e. Slip hub (5) of capacitor shutter over end of compliance arm shaft, tightening socket head screw (9) just enough to hold hub on shaft.

f. Mount air capacitor stator (8) to under side of top plate with one screw (1/2 - inch) (7), and two screws (5/8-inch) (6), applying Loctite 242 to screws before insertion.

g. Slip blade (4) of capacitor shutter between two upper plates of capacitor stator (8), and attach to hub (loosen hub if required) with two screws (1), lockwashers (2), and flatwashers (3).

h. Rotate compliance arm assembly to front bumper and secure with Ty-rap.

i. Loosen hub socket head screw (9) slightly, rotate capacitor shutter blade (4) to within 0.1 inch of power supply housing, and adjust height of hub so that rotor blade does not bind on either plate of capacitor stator (8).

j. Tighten hub socket head screw (9).

k. Remove Ty-rap securing compliance arm assembly to front bumper and allow compliance arm to rotate to rear bumper (under its own weight). If compliance arm does not swing freely, readjust height of capacitor shutter, steps i and j, until compliance arm swings freely.

l. Tighten hub socket head screw (9).

m. Attach compliance arm spring (10) to bracket (11).

n. Clip wire terminals to air capacitor stator (8) plates at points from which removed in step b, paragraph 4-30.

o. Place transport in operator maintenance access position (paragraph 4-2).

CAUTION

To prevent data reliability problems due to improper tape tension the position of the compliance arm spring bracket (11) is factory aligned and should not be changed unless necessary.

p. If spring bracket position was changed, adjust for proper spring tension as follows:

(1) Attach 0 to 36 oz. spring scale, available from John Chatillon & Sons, 83-30 Kew Gardens Rd., Kew Gardens, New York 11415, Part No. LP36, to compliance arm by inserting hook end of scale into notch provided on top of compliance arm near the pivot point.

(2) Loosen screw (22) attaching bracket (11) and position bracket so that screw (22) is in the center of its slotted adjustment range.

(3) Pull spring scale toward front panel of transport until compliance arm roller is positioned between 4th and 5th row (from front panel) of holes in top plate. Scale must be held perpendicular to compliance arm.

(4) With compliance arm positioned between 4th and 5th holes in top plate, spring scale should indicate 19 ±2 ounces. Adjust spring bracket to obtain this reading by moving bracket to stretch or shorten spring. Any deviation from zero reading should be added or subtracted from spring scale reading.

(5) Verify that minimum spring tension required to move arm from rest position is 10 ounces.

(6) If readjustment is required in either substep (4) or (5), reverify both readings.

q. Use Service Aid 24 to test compliance arm and air capacitor assemblies.

TAPE-IN-PATH SENSOR, TRANSMITTER (10, Figure 4-5).

4-32. **Removal and Replacement (Figure 4-18).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Remove connector at back of top plate from tape-in-path sensor transmitter.

b. Remove two screws (1, Figure 4-18) and lockwashers (2) and pull transmitter (3) carefully through hole from back of top plate.

c. Position replacement sensor transmitter carefully in place through hole from back of top plate and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, transmitter.

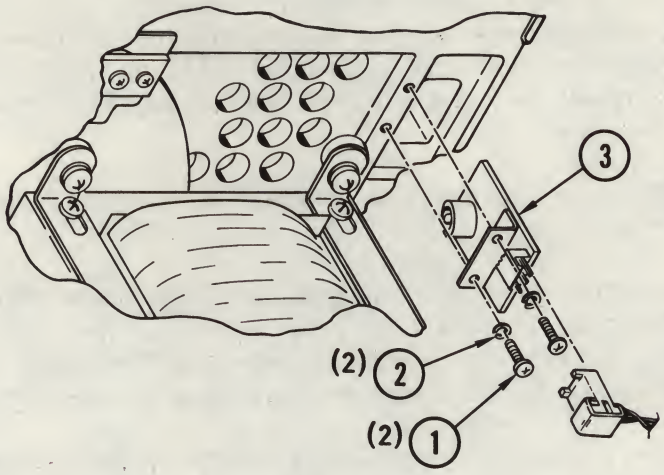

Figure 4-18. Tape-in-Path Sensor, Transmitter

TAPE-IN-PATH SENSOR, RECEIVER (11, Figure 4-5).

4-33. **Removal and Replacement (Figure 4-19).** Place the transport in service access position in accordance with paragraph 4-2 and proceed as follows:

a. Remove connector at back of top plate.

b. Remove attaching screw (1, Figure 4-18), lockwasher (2), and flatwasher (3) and remove tape-in-path sensor receiver (4). Save attaching parts for reassembly.

c. Install replacement receiver using screw (1), lockwashers (2) and flatwasher (3).

d. Reinstall connector.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, receiver.

COMPLIANCE ARM BUMPER ASSEMBLY (12, Figure 4-5).

4-34. **Removal and Replacement (Figure 4-20).** With the transport in operator maintenance position (paragraph 4-2), proceed as follows:

a. Remove screw (1, Figure 4-20), lockwasher (2), and bumper assembly (3).

b. Reinstall in reverse order of removal, and adjust to contact compliance arm squarely. Ensure spring (4) does not touch bumper in the compliance arms full arc of travel. Reposition bumper to clear spring if required.

c. Place transport in operating position.

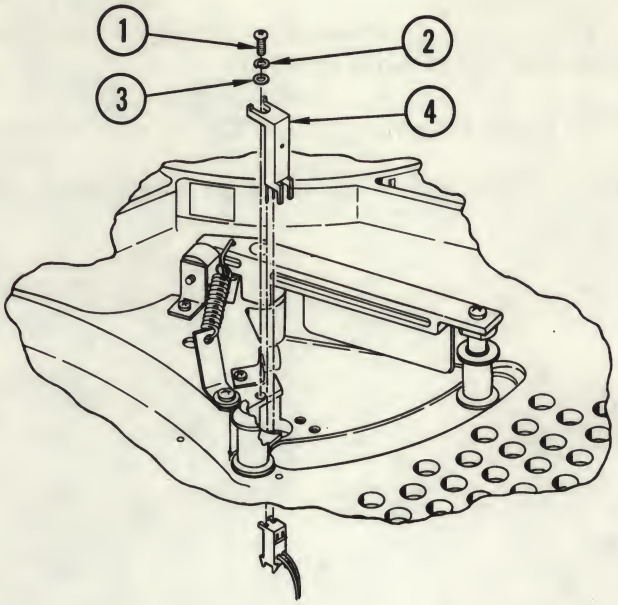

Figure 4-19. Tape-in-Path Sensor, Receiver

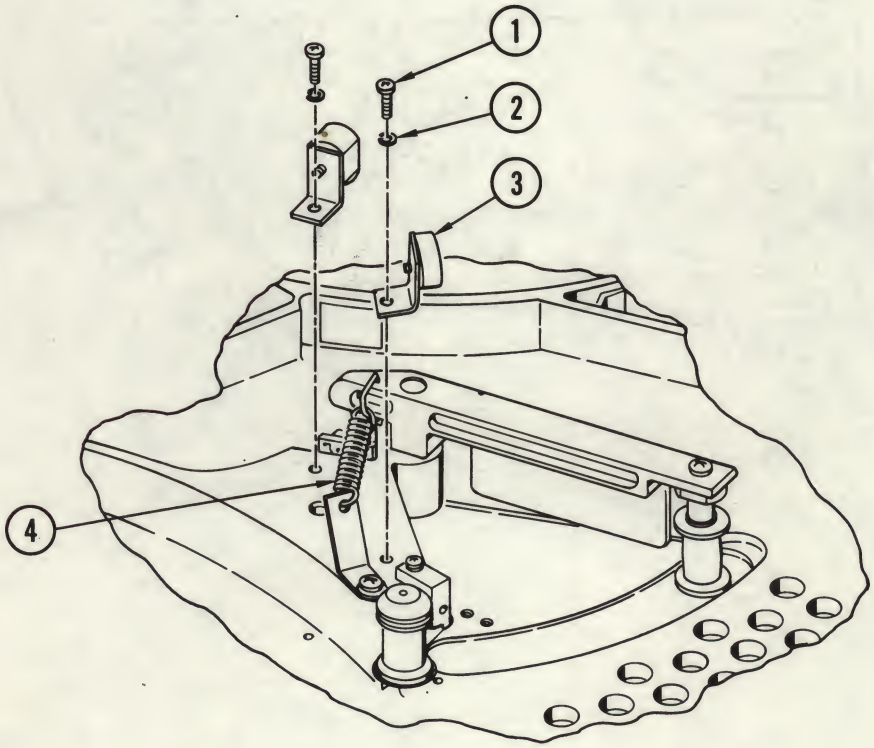

Figure 4-20. Compliance Arm Bumper Assembly

ROLLER TAPE GUIDE ASSEMBLY (SOLID) (13, Figure 4-5).

4-35. **Removal and Replacement (Figure 4-21).** Place the transport in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove attaching screw (1, Figure 4-21) and lockwasher (2), and leaving shims in place remove tape guide assembly (solid) from top of top plate. Save attaching parts for reinstallation.

b. Reinstall tape guide assembly (solid) (3) in reverse order of step a.

c. Perform tape alignment procedure in accordance with instructions in paragraph 4-50.

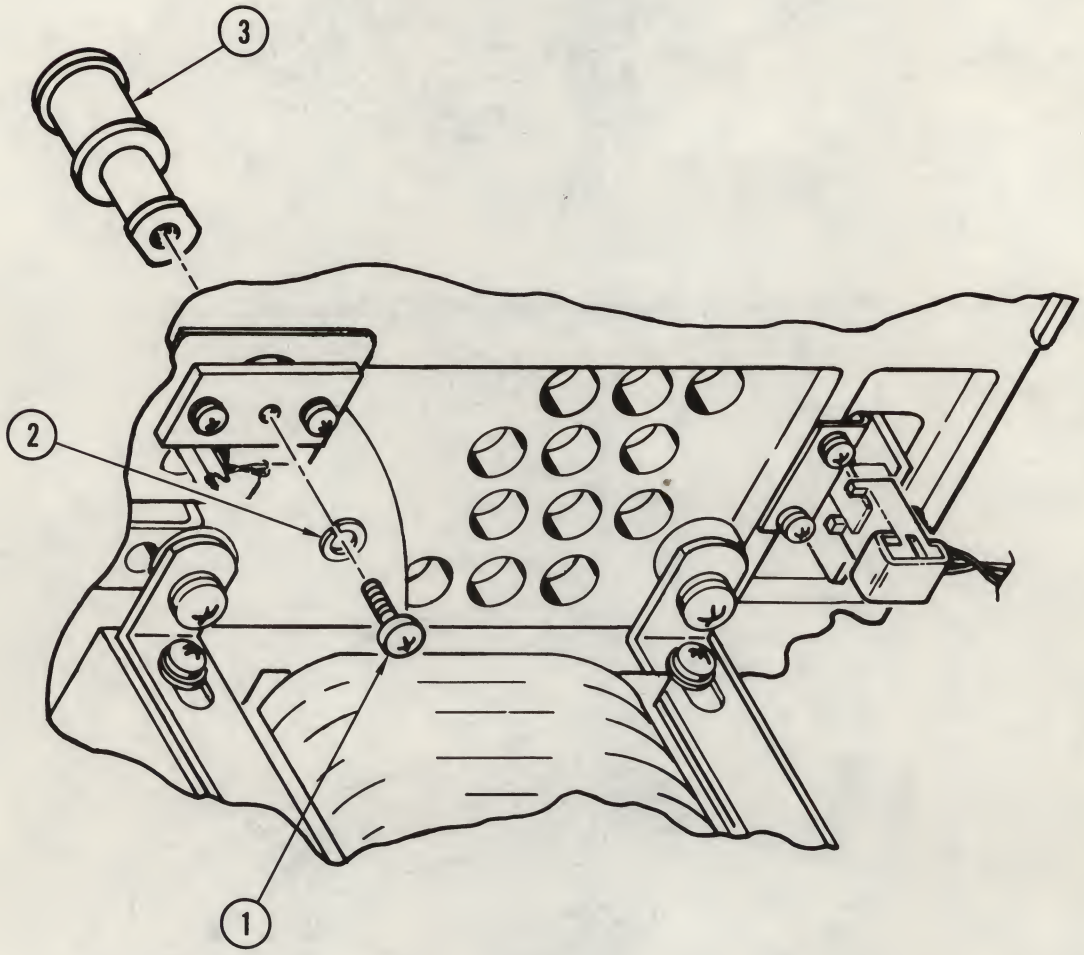

Figure 4-21. Tape Guide Assembly (Solid)

FILE-PROTECT SENSOR (14, Figure 4-5).

4-36. **Removal and Replacement (Figure 4-22).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Remove connector (back of top plate) from file-protect sensor (3, Figure 4-22).

b. Remove two screws (1) and lockwashers (2) and pull sensor (1) carefully through hole of top plate. Save attaching parts for reassembly.

c. Position replacement sensor carefully through hole and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test file-protect sensor.

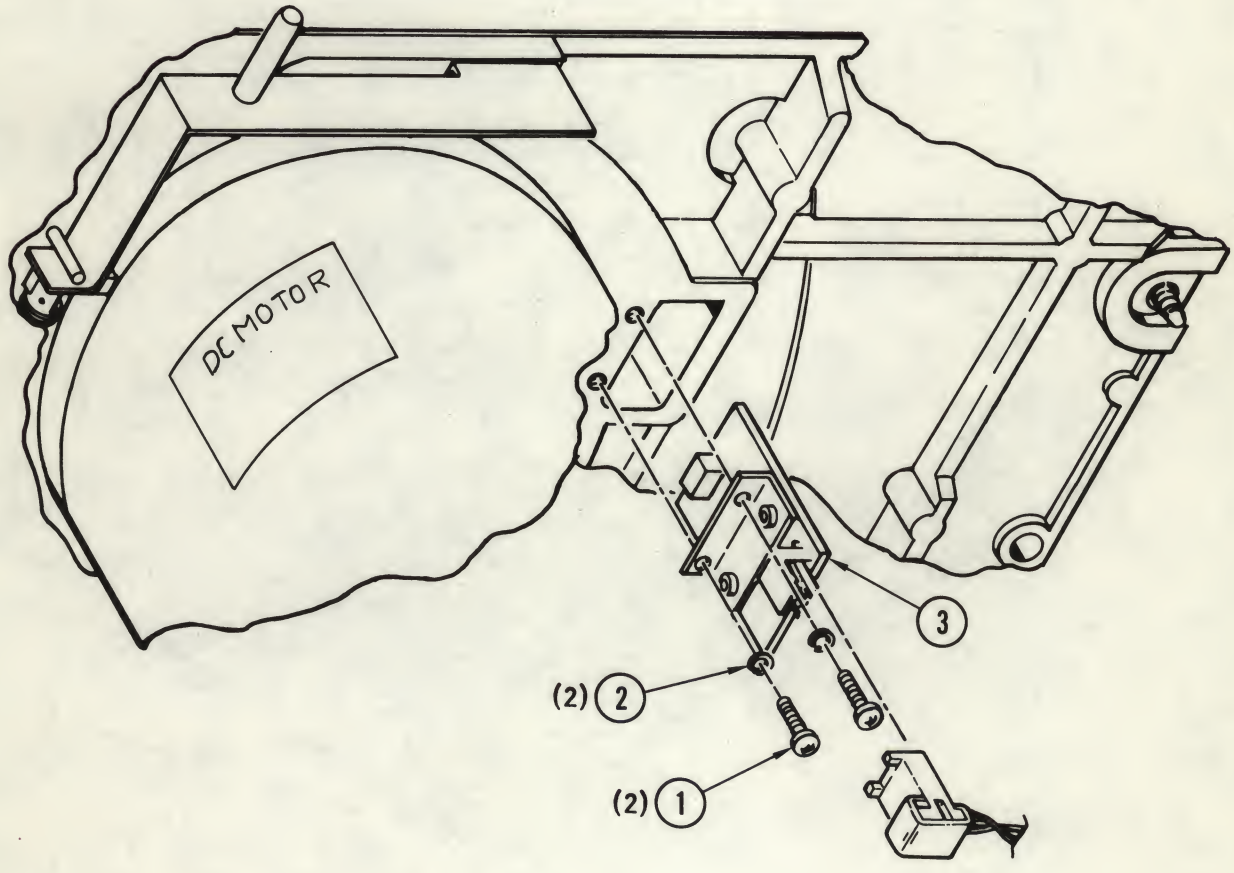

Figure 4-22. File-Protect Sensor

DRIVE MAIN PRINTED WIRING BOARD (PWB) ASSEMBLY (1, Figure 4-6).

4-37. **Removal and Replacement (Figure 4-23).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove power cord from outlet.

b. Remove screw (1), lockwasher (2), and flat washer (3) from front center of board.

c. Remove all side connectors and ground wire.

d. Lift front of board over lip on chassis, slide forward and remove I/O connectors.

e. Remove board from chassis.

f. Position replacement board and install I/O connectors.

g. Reconnect all side connectors and ground wire.

h. Secure board with screw (1), lockwasher (2), and flat washer (3).

i. Place transport in operating position.

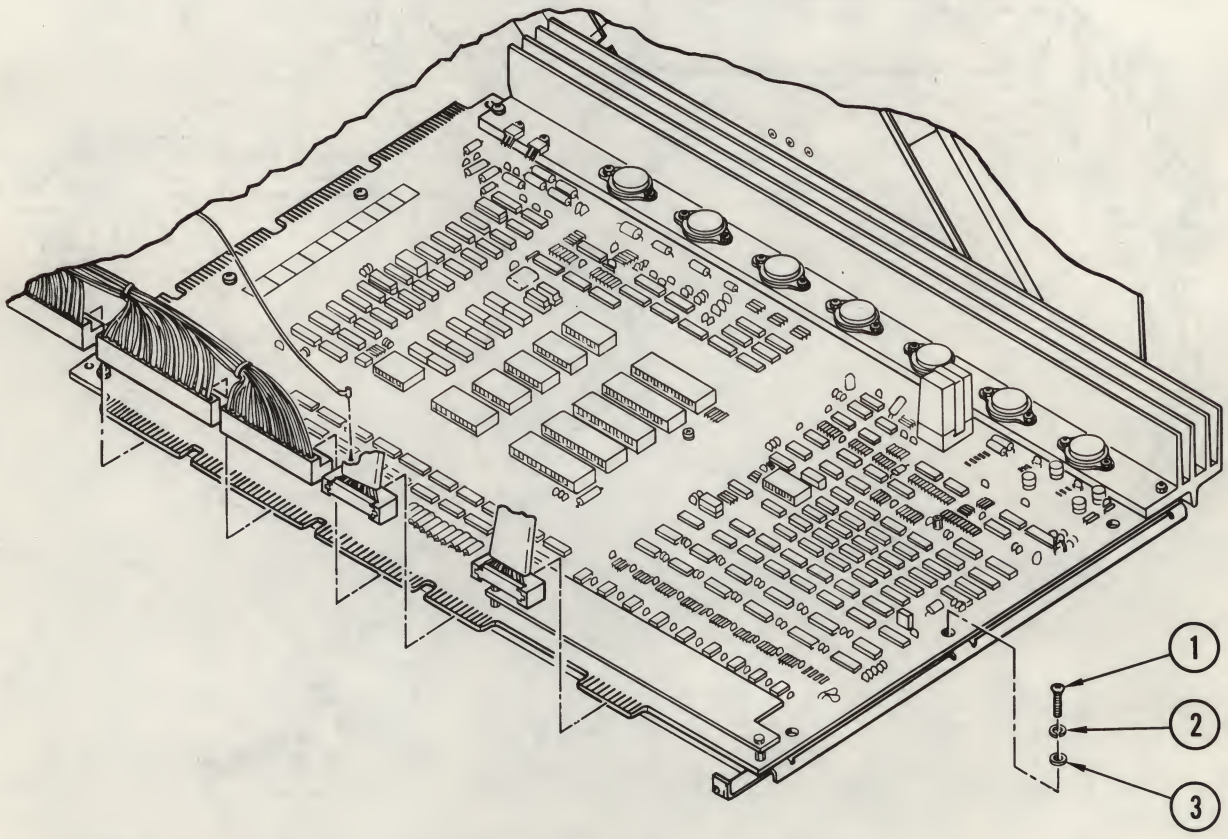

Figure 4-23. Drive Main Printed-Wiring Board

POWER SUPPLY ASSEMBLY (2, Figure 4-6).

4-38. **Removal and Replacement (Figure 4-24).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Turn power off and remove power cord from rear of power supply chassis.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

NOTE

Although not required, the following steps are simplified by removal of the top plate air duct (paragraph 4-41), front panel air duct (paragraph 4-42) and air intake tube (paragraph 4-43).

c. Remove screw (1, Figure 4-24), lockwasher (2), and flatwashers (3) securing ground wire terminal (4), and power supply cover (5).

d. Cut Ty-raps (5 places) securing wiring harness to outside of power supply chassis, and disconnect wiring harness connector from power supply PWB.

e. Remove screws (6), lockwashers (7), and flatwashers (8) securing power supply chassis to top plate.

f. Remove screws (9), lockwashers (10), and flatwashers (11) securing chassis to rear bracket.

g. Disconnect air pump wires (16) and terminals from EMI filter (15) noting position from which removed.

h. If air pump assembly (20) is to be replaced, remove nuts (17), lockwashers (18), and flatwashers (19) securing air pump to chassis.

i. Install replacement assembly in reverse order of removal ensuring transformer and power switch wire bundles are routed through the housing opening near the top plate.

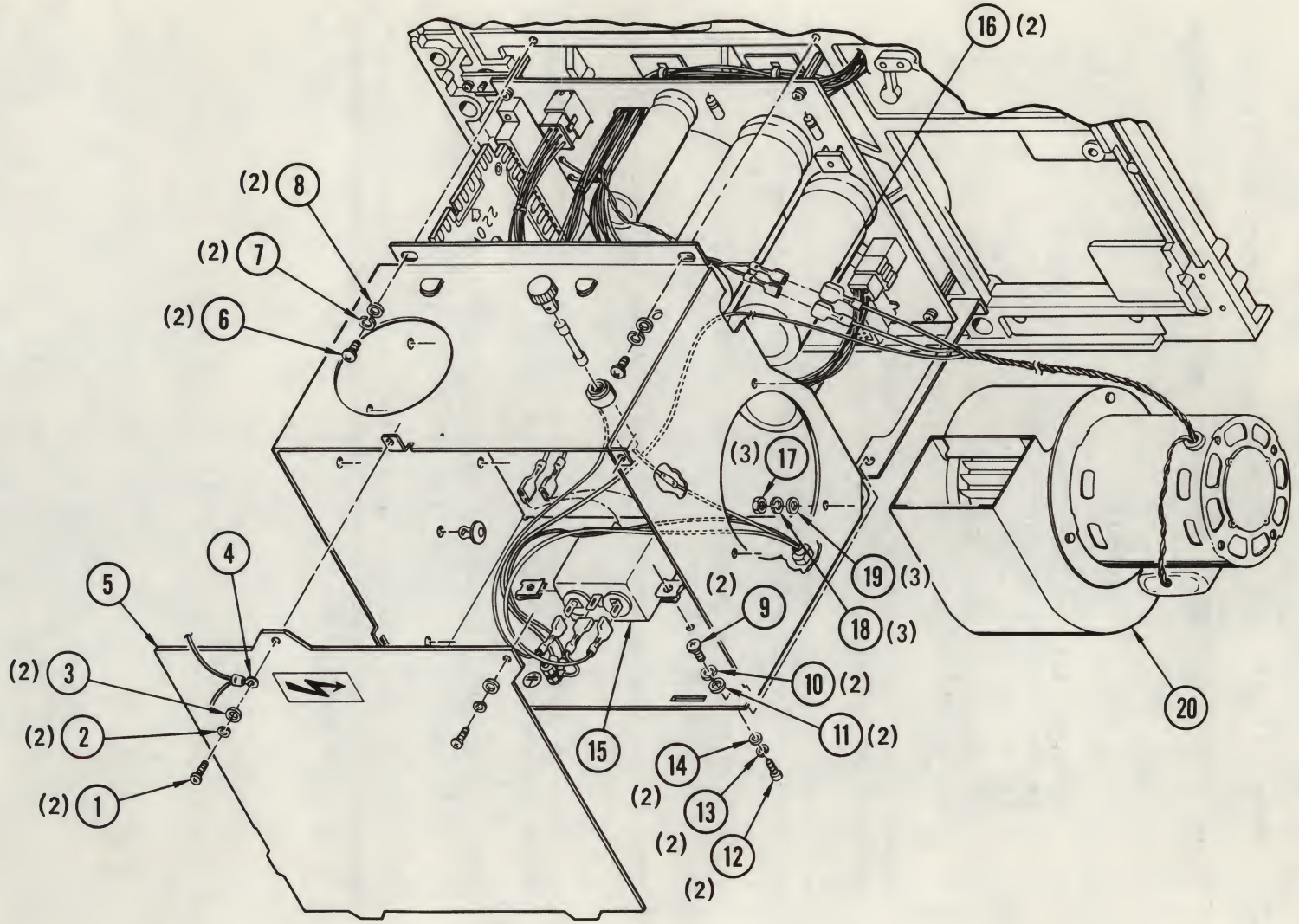

Figure 4-24. Power Supply Assembly

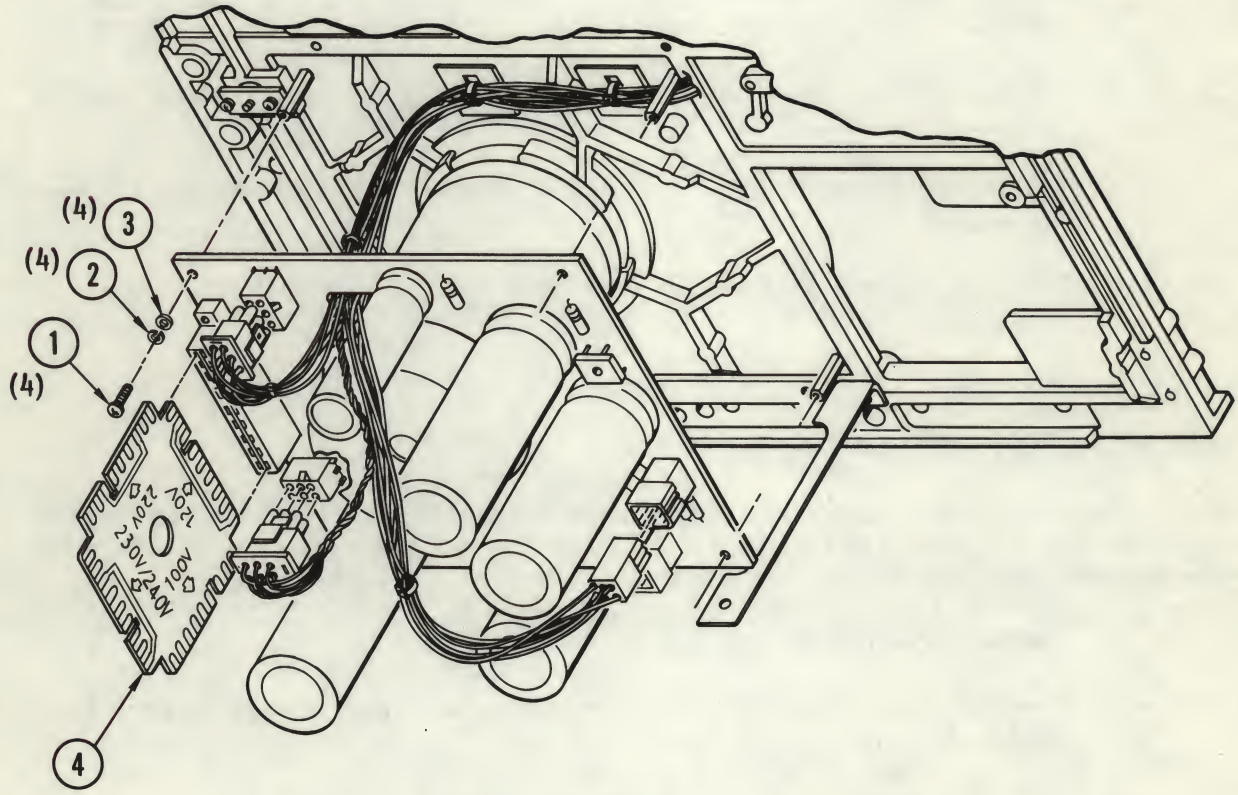

Figure 4-25. Power Supply PWB

POWER SUPPLY PWB (3, Figure 4-6).

4-39. **Removal and Replacement (Figure 4-25).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove power supply assembly in accordance with instructions in paragraph 4-38.

d. Disconnect all wiring harness connectors from power supply PWB.

e. Remove screws (1), lockwashers (2), and flatwashers (3), and carefully lower power supply PWB while feeding cables through board opening. Remove voltage selection card (4).

f. Reconnect all connectors to replacement PWB and replace voltage selection card (4).

g. Hold PWB in place and secure with screws (1), lockwashers (2), and flatwasher (3).

h. Replace power supply chassis in reverse order of instructions in paragraph 4-38.

i. Place drive in operating position.

TAKEUP MOTOR ASSEMBLY (4, Figure 4-6).

4-40. **Removal, Replacement and Adjustment (Figure 4-26).** Place the transport in service access position, in accordance with paragraph 4-3, and remove and replace the takeup motor assembly in accordance with the following procedure:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove takeup hub in accordance with paragraph 4-29.

d. Remove power supply assembly cover in accordance with instructions in paragraph 4-38.

e. Disconnect motor wire terminals identifying as necessary for reinstallation.

f. Remove four screws (1, Figure 4-26), lockwashers (2), flatwashers (3), shoulder washers (4), and takeup motor (6) out of drive, noting orientation of motor. Save attaching parts, including insulator (5), for use in assembly.

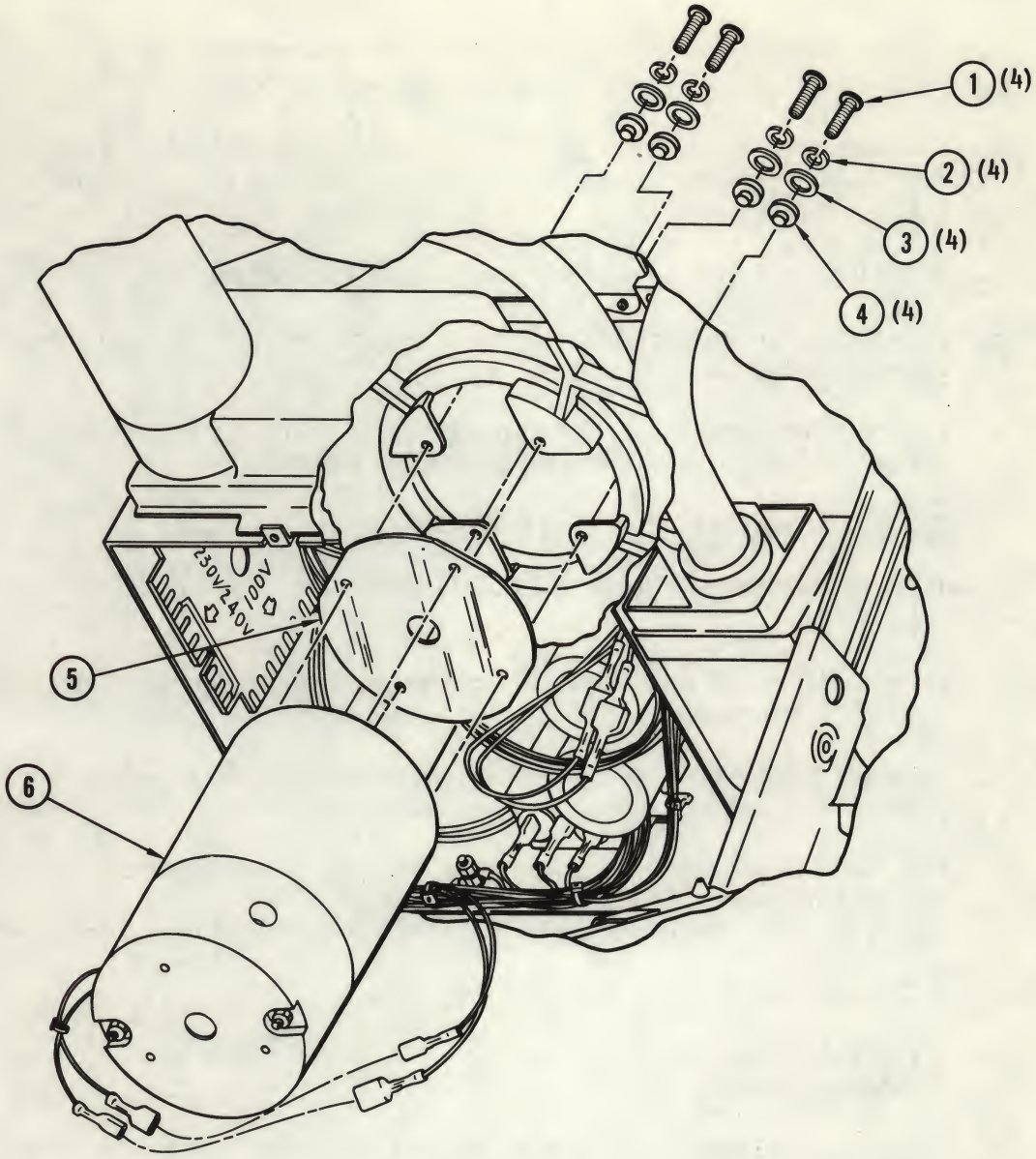

Figure 4-26. Takeup Motor Assembly

g. Install replacement motor in same orientation as motor removed in step f, in reverse order of steps e and f.

h. Reinstall power supply cover in accordance with instructions in paragraph 4-38.

i. Reinstall and adjust takeup hub in accordance with paragraph 4-29.

j. Reinstall main PWB in accordance with instructions in paragraph 4-37.

k. Use Service Aid 11 to test motor operation.

AIR DUCT, TOP PLATE (5, Figure 4-5), AIR DUCT, FRONT PANEL (6), TUBE, AIR INTAKE (7).

4-41. **Removal and Replacment (Figure 4-27).** Place the transport in service access position (paragraph 4-3). To replace the top-plate air duct, proceed as follows:

a. Remove head connectors J6/J7 from main PWB and cable retractor (5). At top-plate end of top-plate air duct (4), remove screw (1), lockwasher (2), and flatwasher (3).

b. Pull other end from blower adapter (6), and remove air duct.

c. Remove cable retractor (5) from old duct and secure with Ty-rap on replacement duct.

d. Install replacement duct by slipping flared end over blower adapter (6) and reinstalling screw, lockwasher and flat washer.

e. Place transport into operating position.

4-42. **Front Panel Air Duct (Figure 4-27).** Replace the front panel air duct as follows:

a. Note positions of power switch harness and safety pin retractor Ty-raps on duct and remove.

b. Remove front panel in accordance with instructions in paragraph 4-21, steps a, b, and c, but do not remove switch wire terminals and connectors.

c. Pull front panel just far enough away from transport to remove gooseneck end of front-panel air duct (7), noting position from which removed with reference to air deflector on front, right-hand edge of top plate.

d. Pull other end of duct off blower adapter (6).

e. To install replacement front-panel air duct (7), place flared end of duct on blower adapter.

f. Position gooseneck end of duct so that it opens into air deflector and holding end of duct in place, replace front-panel assembly, squeezing positioning block of front-panel over gooseneck, ensuring that air intake tube (8) is in place in front-panel adapter (9) and power supply.

g. Reinstall front panel assembly in accordance with paragraph 4-21, step f.

h. Fasten power switch wiring harness and safety pin retractor to duct with Ty-raps per step a notation.

i. Place transport in operating position.

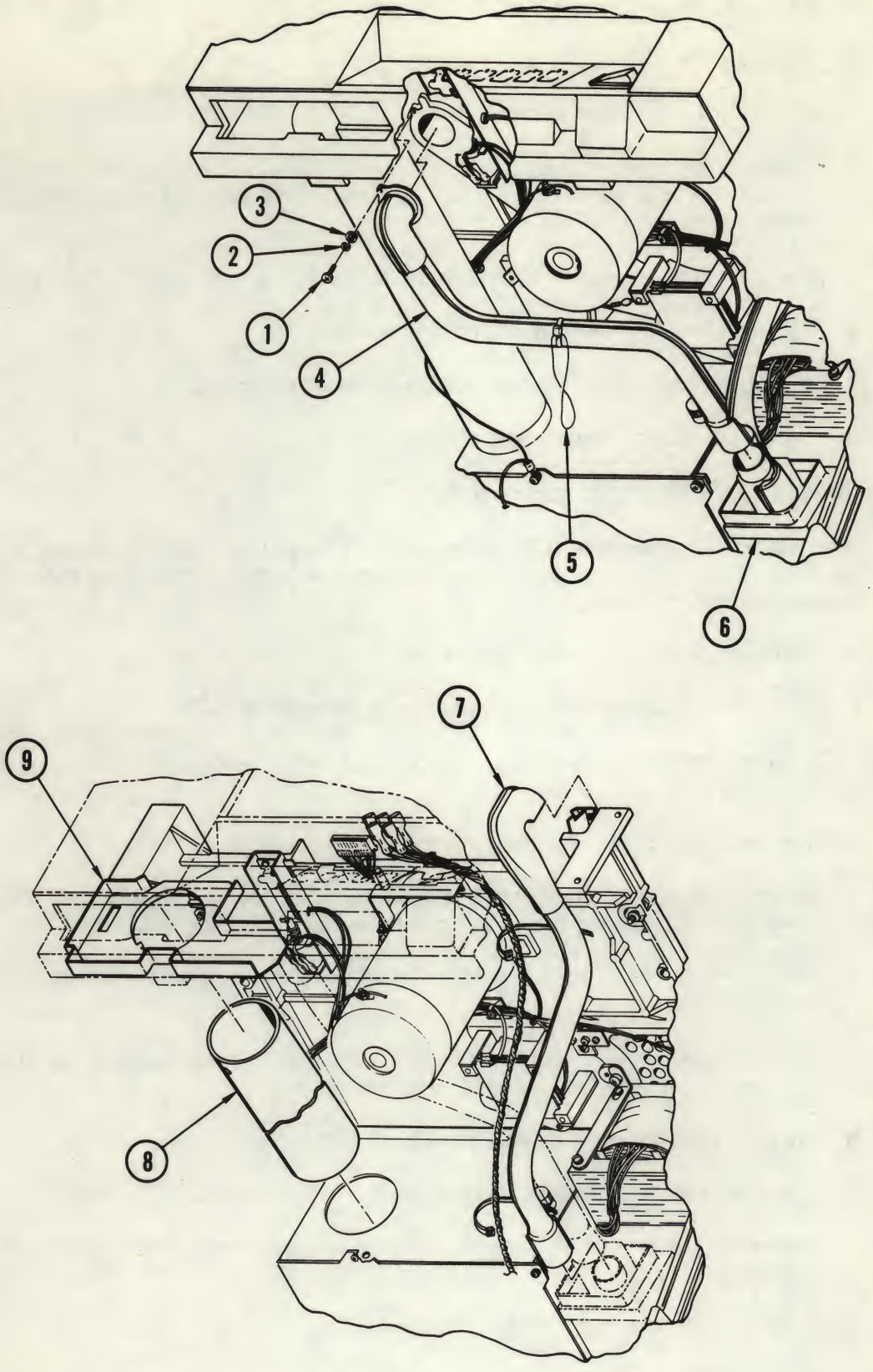

Figure 4-27. Top Plate Air Duct,
Front Panel Air Duct, Air Intake Tube

4-43. **Air Intake Tube. (Figure 4-27).** Replace the air intake tube as follows:

a. Remove the filter. Refer to paragraph 4-13.

b. Place unit in service access position.

c. Remove air intake tube (8) from power supply case by depressing tube slightly at hole (bottom of tube) to disengage tooth and slide forward into front panel adapter (9).

d. Remove front panel as in paragraph 4-42, but do not remove Ty-raps, etc.

e. Slide air intake tube out of front panel adapter.

f. Install replacement tube in reverse order of removal.

g. Place transport in operating position.

SUPPLY MOTOR ASSEMBLY (8, Figure 4-6).

4-44. **Removal and Replacement (Figure 4-28).** Place transport in service access position, in accordance with instructions in paragraph 4-3, and remove and replace the supply motor assembly as follows:

a. Remove power cord from outlet.

b. Remove supply hub in accordance with paragraph 4-23.

c. Disconnect motor wire terminals from wire leads, identifying each as necessary for reinstallation.

d. Remove bell crank retaining ring (5, Figure 4-28).

e. Remove screw (1) lockwasher (2), flatwasher (3), shoulderwasher (4), and insulator (6), holding motor (7) as last screw is being removed.

f. Lower motor (7) from top plate, simultaneously slipping bellcrank off post on top of motor.

g. Install replacement motor with bellcrank post nearest bellcrank, slipping bellcrank onto post, in reverse order of removal.

h. Install retaining ring on bellcrank post (paragraph 4-45).

i. Connect motor wire terminals as identified in step c.

j. Reinstall and adjust supply hub in accordance with instructions in paragraph 4-23.

k. Use Service Aid 11 to test motor operation.

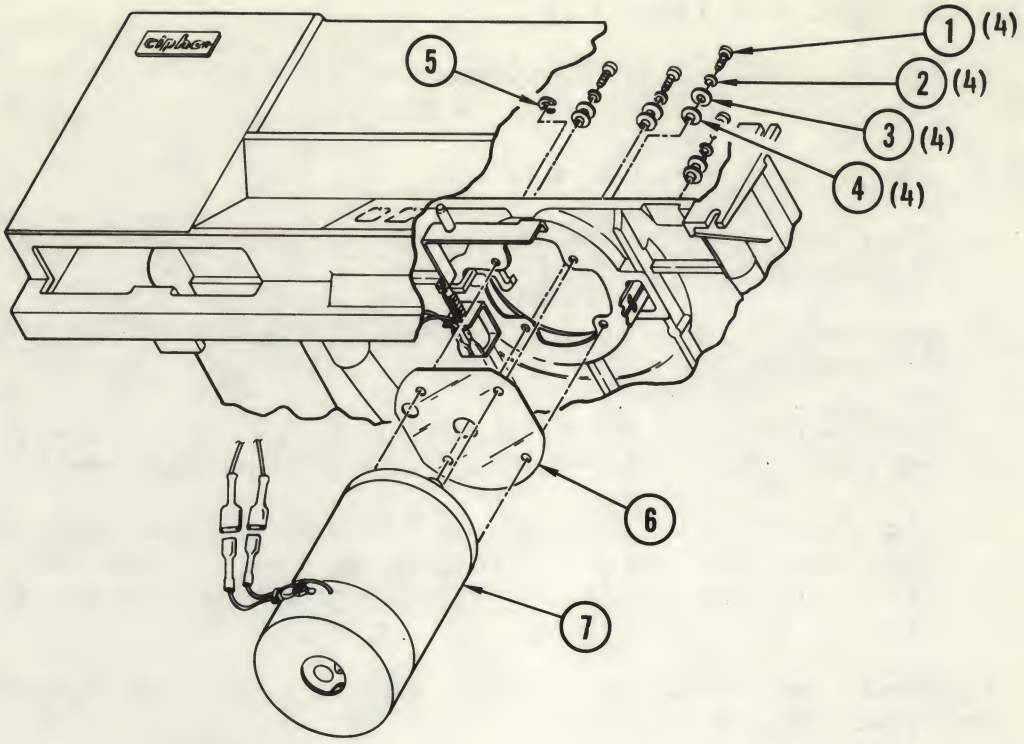

Figure 4-28. Supply Motor Assembly

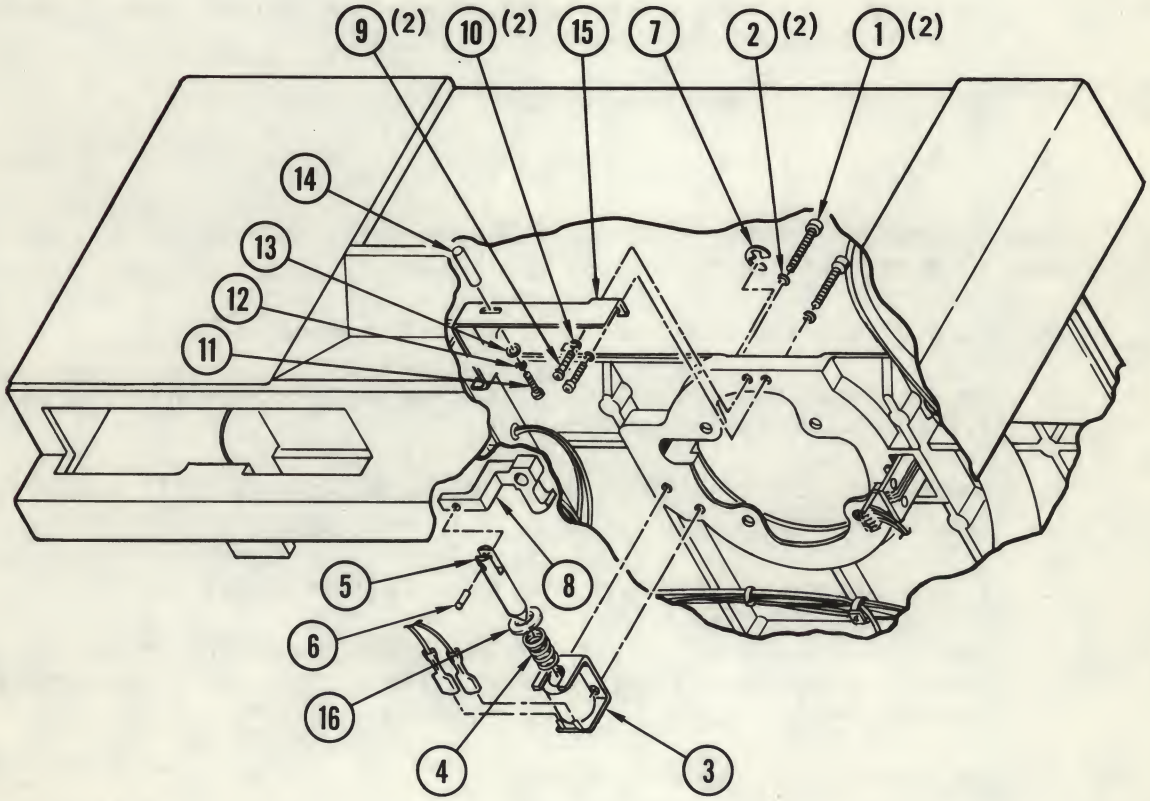

Figure 4-29. Hub Lock Assembly

HUB LOCK ASSEMBLY (10, Figure 4-6).

4-45. **Disassembly, Removal and Replacement (Figure 4-27).** To disassemble hub lock assembly and remove parts from top plate and supply motor, proceed as follows:

a. Remove power cord from outlet.

b. Place transport in service access position in accordance with instructions in paragraph 4-3.

c. Remove wire terminals from solenoid (3, Figure 4-27) and identify for reassembly.

d. Remove two screws (1), and lockwashers (2), and remove solenoid (3) from top plate and spring (4) and washer (16) from solenoid plunger (5).

e. If plunger (5) or bellcrank (8) must be replaced, remove supply motor in accordance with instructions in paragraph 4-44. Remove retaining ring (7) and bellcrank (8) from motor, and press out pin (6), releasing plunger (5).

4-46. **Reassembly and Installation.** Replace defective parts, and reassemble and install the hub lock assembly as follows:

a. Install bellcrank (8) on supply motor with retaining ring (7). Reinstall motor on top plate in accordance with instructions in paragraph 4-44.

b. Complete reassembly and reinstall solenoid (3) on top plate in reverse sequence of steps c and d, paragraph 4-45.

c. Place transport in operating position.

d. Use Service Aid 32 to test hub lock assembly operation.

4-47. **Manual Unlock Assembly (Hub Lock) (Figure 4-27).** To replace the manual unlock assembly or one of its parts, proceed as follows:

a. Place transport in service access position (Paragraph 4-3).

b. Remove manual unlock assembly from top plate by removing two screws (9, Figure 4-27) and lockwashers (10).

c. Remove pin (14) from bracket (15) by removing screw (11), lockwasher (12), and flatwasher (13).

d. Reassemble and reinstall in reverse order of steps b and c.

e. Ensure that the hub lock solenoid spring will return the manual unlock assembly fully against the stop pin. Reposition the manual unlock assembly if required.

f. Place transport in operating position.

DOOR LOCK ASSEMBLY (11, Figure 4-6).

4-48. **Removal and Disassembly (Figure 4-30).** Place the transport in service access position in accordance with instructions in paragraph 4-3. Remove the door lock assembly from the top plate and disassemble as necessary to replace defective parts as follows:

a. Remove power cord from outlet.

b. Remove wire terminals from solenoid noting positions for reassembly.

c. Remove door lock assembly from top plate by removing two screws (1, Figure 4-30) and lockwashers (2).

d. Remove slip-on connectors from microswitch noting positions for reassembly and feed through grommet.

e. Remove two screws (3), and lockwashers (4), and remove solenoid (5) from assembly. Remove spring (6) and spacer (7).

f. Remove switch (13), by removing two nuts (8), lockwashers (9), flat washers (10), screws (11) and flat washers (12). Switch may then be removed by sliding out solenoid end of bracket.

g. No further disassembly is recommended.

h. Replace defective parts, and reassemble door lock assembly in reverse sequence of disassembly, steps c and d.

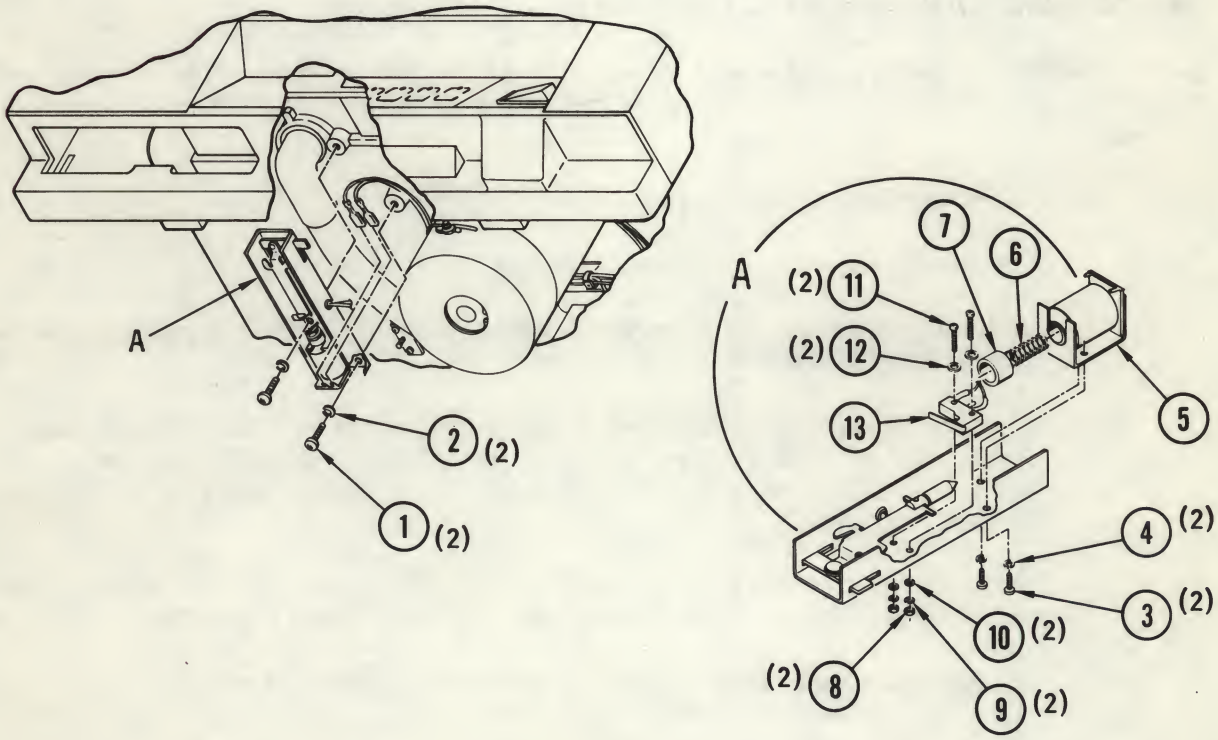

Figure 4-30. Door Lock Assembly

i. Install door lock assembly on top plate with attaching parts removed in step b. Do not tighten screws.

j. Adjust position of door lock assembly as follows:

(1) Close top cover of transport. Position door lock assembly so that the plate is approximately 1/8 inch in front of latching arm of cover lock tab (6, Figure 4-14), and tighten screws.

(2) Applying very light pressure, attempt to close transport door. If door will not close completely, loosen screws (1), push door lock assembly forward until door will close, and retighten screws (1).

(3) Place drive in operating position and connect to power source.

(4) Actuate POWER switch and LOAD touch switch. If only LOAD and POWER indicators illuminate, door lock assembly is properly positioned and adjustment is complete.

(5) If all indicators except ON-LINE are flashing upon excecution of step (4), place drive in service access position, loosen screws (1), and pull door lock assembly slightly toward rear of unit.

(6) Repeat steps (3), (4), and (5) until both top cover and door open with POWER switch off and only LOAD and POWER indicators illuminate when these switches are actuated.

k. Place transport in operating position.

TRANSFORMER ASSEMBLY (12, Figure 4-6).

4-49. **Removal and Replacement (Figure 4-31).** To replace the transformer assembly, place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB from transport (paragraph 4-37).

c. Remove power supply assembly and power supply PWB in accordance with paragraphs 4-38 and 4-39.

d. Unplug primary and secondary transfomer connectors from power supply PWB, and cut all Ty-raps securing transformer wire bundles to power supply components and other parts of drive, noting position of Ty-raps before removing.

e. Support transformer (4, Figure 4-31) and remove four screws four (1), four lockwashers (2), and four flatwashers (3), and remove from drive.

f. Install replacement transformer in reverse sequence of step e.

g. Replace Ty-raps removed in step c.

h. Reinstall power supply PWB in accordance with paragraph 4-39, ensuring that transformer wire bundles are properly secured with Ty-raps.

i. Plug in transformer primary and secondary connectors to power supply.

j. Reinstall power supply assembly in accordance with paragraph 4-38, and reinstall drive main PWB in accordance with paragraph 4-37.

k. Place drive in operating position.

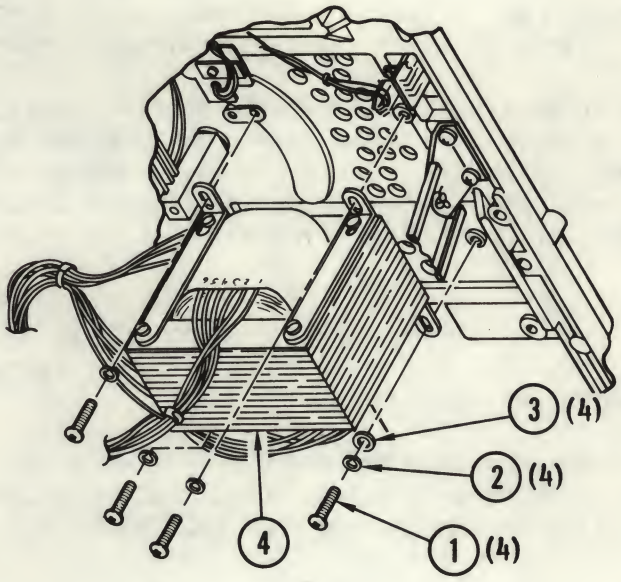

Figure 4-31. Transformer Assembly

TAPE ALIGNMENT

4-50. All tape guides must be checked for proper tape path alignment following replacement of any part in the tape path. Proceed as follows:

a. Actuate power switch to ON.

b. Insert and load a new tape.

NOTE

A used tape may have damaged or weak edges which would adversely affect its tape-path tracking characteristics.

c. Use Service Aid 33 to disable door and top cover lock. Place drive in operator maintenance access position.

d. Ensure that supply reel is properly seated on supply hub.

e. Referring to paragraph 3-32, operate drive in Service Aid 23.

f. If tape is not centered between sides of reel, unload tape and adjust hub height as necessary.

g. Observe position of tape on roller guide (2, Figure 4-32).

h. If tape is not centered on guide, turn power switch to OFF, and remove guide (2) from compliance arm in accordance with paragraph 4-30 step i and Figure 4-17.

i. Add or reduce thickness of shims (20) as required to compensate for off-center position of tape and reinstall guide on compliance arm. Repeat as necessary to obtain correct centering of tape on guide (2).

j. Run tape forward and check for edge curl on guide (3). If curl is present on lower washer, turn power switch to OFF and increase shims under roller guide (1). If curl is present on upper washer of guides (3), decrease shim thickness under roller guide (1). Resume forward tape motion and recheck tape position. Repeat this step until tape tracks smoothly around guide (3).

k. Depress lower washer on guide (3) and check for optimum movement of tape away from top washer of 0.005 inch. If necessary, reshim guide (2) to maintain proper tape centering.

l. Run tape in forward direction and check for edge curl on guide (4). If curl is present, turn transport power to OFF and add or remove shims on guide (5). Do not alter guide (5) more than ±0.005 inch from factory setting.

NOTE

Curl on guide (4) can be caused by improper alignment on any other guide in the tape path. If tracking has been verified on guide (3), tape curl on guide (4) is probably caused by misalignment of guide (5). Normally, improper alignment of guides (1) and (2) will show up as tracking problems on guide (3).

m. Run tape in reverse direction (Service Aid 23) and check for tape curl on all edges.

n. Depress lower washer on guides (3), (4), and (5) and check for optimum tape movement, away from top washer, of 0.005 inch.

o. Add or delete shims on guides (1), (2) and (5) as required to eliminate edge curl on all rollers and reverify forward tape path alignment by checking for maximum tape shift on guide (2) of ±0.015 inch.

p. Check head azimuth and read skew. Refer to paragraph 4-51.

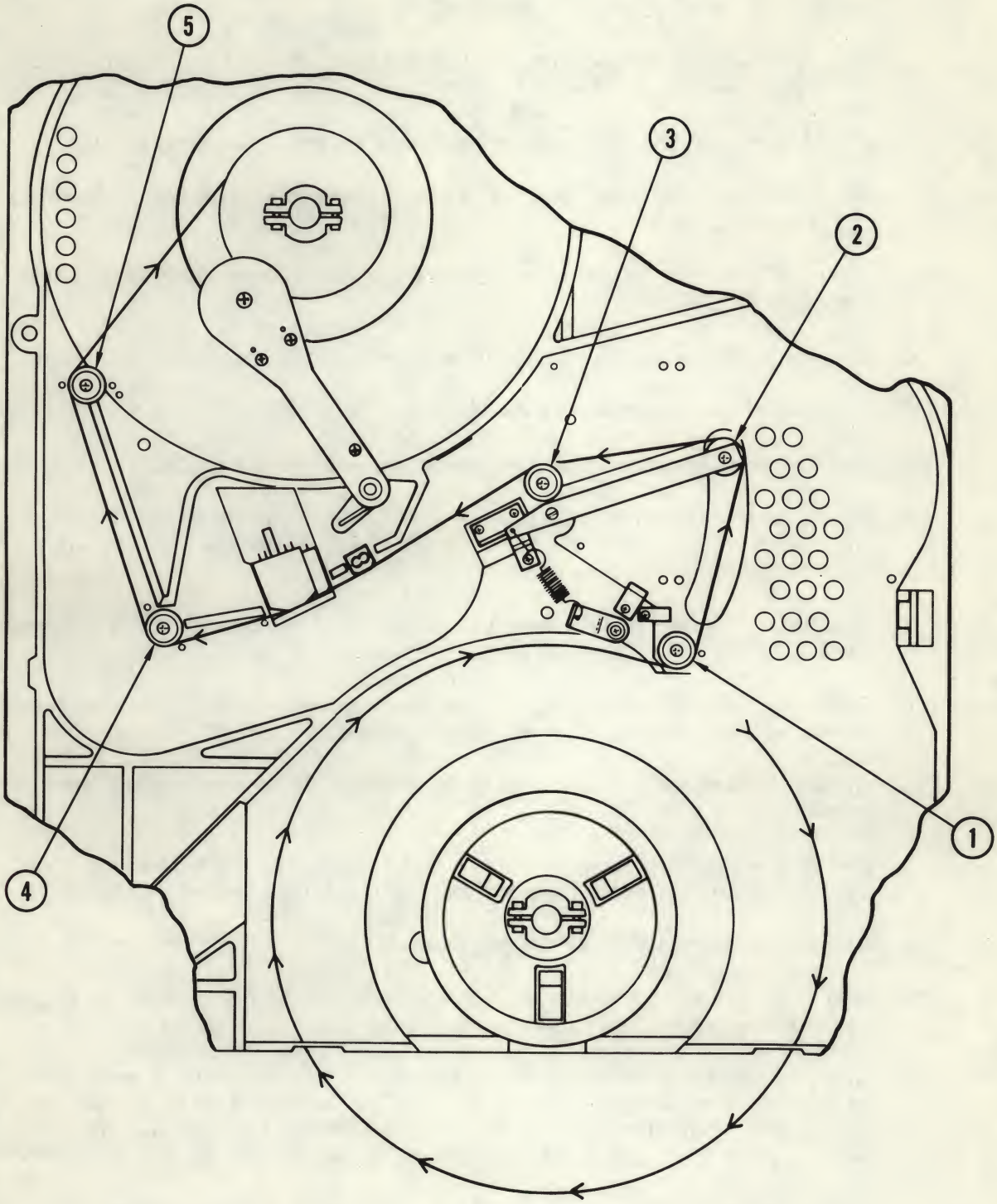

Figure 4-32. Tape Path Adjustment

4-51. **Head Azimuth Adjustment.** Adjust head azimuth as follows:

a. Place drive in service access position.

b. Turn transport power off and attach skew monitor, Cipher Part No. 600047-701 to U14B, U14D, and U14G.

(1) A skew monitor may be constructed using three 14-pin IC clips and nine 47k ohm resistors.

(2) Attach one end of a resistor to pins 9, 11, and 13 on each IC clip.

(3) Connect the other end of all nine resistors together to form a summing junction.

c. Actuate transport power switch to ON and load master skew tape, Cipher Part No. 799019-401.

d. Connect oscilloscope to test point on skew monitor and ground test point.

e. Loosen center adjustment screw (1, Figure 4-11).

f. Referring to paragraph 3-32, operate drive in Service Aid 23.

g. Adjust azimuth screw (1, Figure 4-11) so that outputs of all tracks, as monitored at test point on skew monitor, fall within 24% or less of the byte-to-byte period. (See Figure 4-33)

h. Run tape in reverse direction, using Service Aid 23, and verify reverse skew is within 24% or less of the byte-to-byte period.

i. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing width of skew pulse.

j. Appply torque seal, Cipher Part No. 209994-025 to head of adjustment screw.

k. Remove skew tape from transport and load a Pericomp tracking tape, available from Pericomp Corporation, Natick, Massachusetts 01760.

l. Connect oscilloscope to TP 10 and ground.

m. Run tape in forward direction (Service Aid 23) and compare P1 to P2 on oscilloscope trace. See Figure 4-34.

n. Calculate difference in amplitude (positive peak) between P1 and P2 and refer to Table 4-2 for conversion of volts to inches. If P1 is greater than P2, subtract calculated figure from 0.007 inch. If P2 is greater than P1, add figure to 0.007 inch. Reference edge must be 0.007 $\pm$0.003 inch.

o. Remove skew monitor and place drive in normal operating position.

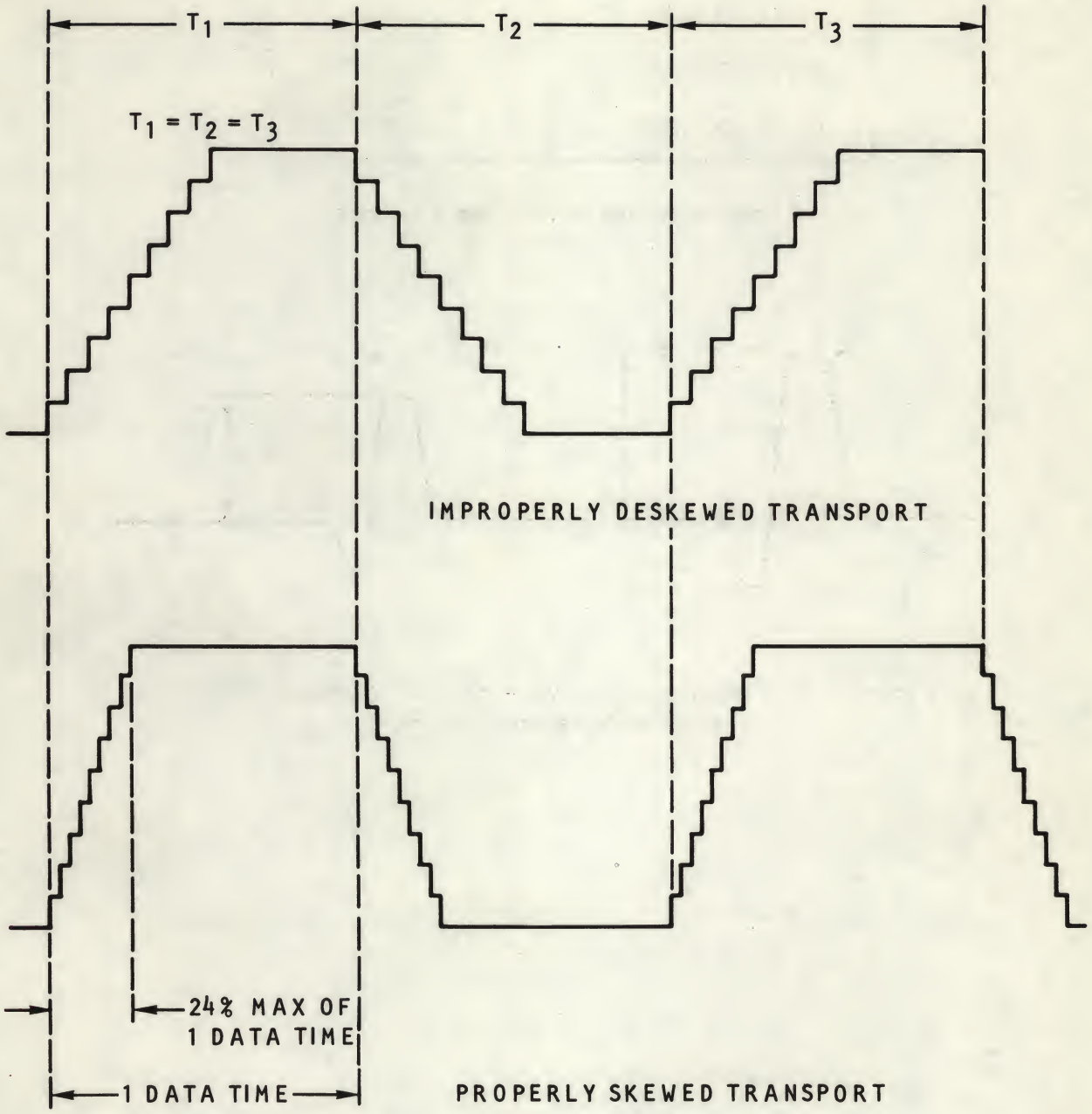

Figure 4-33. Skew Adjustment Waveform

VOLTS	INCHES
0.000 TO 0.024	0.000
0.025 TO 0.049	0.001
0.050 TO 0.074	0.002
0.075 TO 0.100	0.003

Table 4-2. Reference Edge Distance

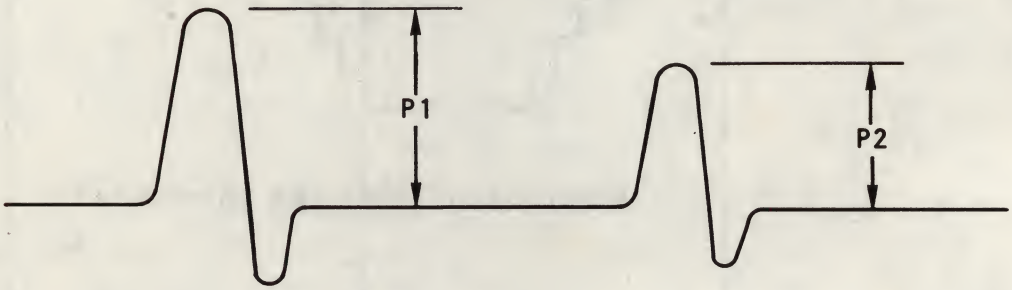

Figure 4-34. Reference Edge Measurement Waveform (TP10)
Using Pericomp Tracking Tape

SECTION V

PARTS LISTS, SCHEMATICS, AND ASSEMBLY DRAWINGS

5-1. This section contains a list of the replaceable parts and associated schematic and assembly drawings for the Model F880 transport.

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
1	460107-304	REF	PICTORIAL-TAPE DRIVE ASSY DIECAST	CIPHER DATA PROD			
2	160107-002	1	PWB ASSY-POWER SUPPLY	CIPHER DATA PROD		04-30-83	L*91
3	960187-001	1	TOP PLATE/CHASSIS ASSY	CIPHER DATA PROD			
ALT	960193-001		TOP PLATE/CHASSIS ASSY-FULL LENGTH JOGGLE	CIPHER DATA PROD			
4	960057-001	1	TOP COVER ASSY	CIPHER DATA PROD		04-01-83	L*92
5	160101-406	1	SUPPLY HUB ASSY	CIPHER DATA PROD			
6	160105-433	1	TACHOMETER ASSY	CIPHER DATA PROD			
ALT	160104-416		TACHOMETER ASSY	CIPHER DATA PROD			
7	160103-499	1	COMPLIANCE ARM ASSY	CIPHER DATA PROD			
8	160103-433	1	TAPE SENSOR ASSY-MOLDED	CIPHER DATA PROD			
9	160106-409	1	HARNESS ASSY	CIPHER DATA PROD			
10	160101-009	1	PWB ASSY-REFLECTIVE SENSOR	CIPHER DATA PROD			
11	160101-010	1	PWB ASSY-REFLECTIVE SENSOR	CIPHER DATA PROD			
12	160101-005	1	PWB ASSY-FILE PROTECT	CIPHER DATA PROD			
13	160104-400	3	ROLLER GUIDE ASSY	CIPHER DATA PROD			
*14	160104-401	1	ROLLER GUIDE ASSY	CIPHER DATA PROD			
15	160101-497	1	SUPPLY MOTOR ASSY	CIPHER DATA PROD			
16	160101-418	1	DOOR LOCK ASSY	CIPHER DATA PROD			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
17	160101-471	1	CAPACITOR PLATE ASSY	CIPHER DATA PROD			
18	160101-444	1	CAPACITOR SHUTTER ASSY	CIPHER DATA PROD			
19	160102-465	1	TRANSFORMER ASSY (P8)	CIPHER DATA PROD			
20	160106-478	1	BUMPER ASSY-COMPLIANCE ARM	CIPHER DATA PROD			
21	160106-479	1	BUMPER ASSY-COMPLIANCE ARM	CIPHER DATA PROD			
22	799031-201	1	MOTOR-PERMANENT MAGNET TAKE-UP	AMETEK,LAMB ELECT DIV 116253-00			
ALT	760101-526		MOTOR-PERMANENT MAGNET, 4" DIA,TAKE UP	AMETEK,LAMB ELECT DIV 116190-00			
23	760106-567	1	HUB-TAKE UP,CAST MACHINING	CIPHER DATA PROD			
24	760101-756	1	INSULATOR-MOTOR	CIPHER DATA PROD			
25	760101-840	1	SOLENOID-COIL	CIPHER DATA PROD			
26	760101-704	1	SPRING-COMPRESSION	CIPHER DATA PROD			
27	760101-746	1	DEFLECTOR-AIR	CIPHER DATA PROD			
28	760103-524	1	DEFLECTOR-AIR,LEFT	CIPHER DATA PROD			
29	760102-509	1	COVER-DEFLECTOR,PLATE	CIPHER DATA PROD			
30	760101-565	1	BRACKET-SPRING,COMP.ARM	CIPHER DATA PROD			
31	760101-759	1	LABEL-WARNING CONNECTOR DISCONNECT	CIPHER DATA PROD			
32	- 34 ARE BLANK.						
35	210006-010	1	SPRING-EXTENSION	THE SPRING WORKS 32382			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
36	210200-032	1	RING-RETAINING,EXT,1/4"	WALDES TRUARC 5100-25			
37	205226-050	1	RING-GRIP,1/4 ID	WALDES TRUARC 5555-25			
38	210229-529	4	CABLE TIE-MOUNT,ADHESIVE APPLIED	PANDUIT AM2-*			
39	210229-524	4	TY-RAP 1/16 - 1 1/4	THOMAS & BETTS TY-24M			
40							
41							
42	760104-520	5	SHIM-STAINLESS STEEL	CIPHER DATA PROD			
43	760104-521	5	SHIM-STAINLESS STEEL	CIPHER DATA PROD			
44	760104-522	2	SHIM-STAINLESS STEEL	CIPHER DATA PROD			
45	760104-523	2	SHIM-STAINLESS STEEL	CIPHER DATA PROD			
46	760104-524	2	SHIM-STAINLESS STEEL	CIPHER DATA PROD			
47	- 51 ARE BLANK.						
52	731911-102	2	SHIM .005THICK 1/4 IN ID	CIPHER DATA PROD ----------			
53	209990-416	AR	ADHESIVE-LOCTITE 416	LOCTITE 416			
54	209990-074	AR	ADHESIVE,NUT LOCK	LOCTITE 242			
55							
56	213274-404	1	SCREW-PAN HD,PHIL 4-40 X 1/4,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
57	213271-405	2	SCREW-PAN HD PHIL, 4-40 X 5/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
58	213271-406	11	SCREW-PAN HD PHIL 4-40 X 3/8 CAD BLK ZINC	ANY ACCEPTABLE SOURCE			
59	213271-407	6	SCREW-PAN HD,PHIL, 4-40 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
60							
61	213091-408	1	SCREW-SKT HD CAP 4-40 X 1/2,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
62	213091-410	2	SCREW-SKT HD CAP 4-40 X 5/8,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
63							
64	213271-605	4	SCREW-PAN HD PHIL 6-32 X 5/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
65	213271-606	1	SCREW-PAN HEAD PHIL, 6-32 X 3/8,CAD BLK,OR ZIN	ANY ACCEPTABLE SOURCE			
66	213271-607	2	SCREW-PAN HD PHIL, 6-32 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
67							
68	213092-612	2	SCREW-SKT HD CAP, 6-32 X 3/4,BLK ONLY	ANY ACCEPTABLE SOURCE			
69	213941-614	2	SCREW-SOC HD,CAP, 6-32 X 7/8,190,000 PSI	UNBRAKO 20097-96C-14			
70	213091-607	4	SCREW-SKT HD CAP, 6-32 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
71	213271-106	4	SCREW-PAN HD PHIL, 10-32 X 3/8,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
72	213271-107	8	SCREW-PAN HD,PHIL 10-32 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
73							
74	207402-021	1	WASHER,FLAT #4	ANY ACCEPTABLE SOURCE			
75	207605-021	7	WASHER,FLAT #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
76	207608-021	4	WASHER,FLAT,SMALL OD #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
77	207104-021	4	WASHER, FLAT,#10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
78	213704-100	8	WASHER-FLAT,#10,S/S	SEASTROM 5710-42-20-P			
79							
80	207403-011	20	WASHER,SPLIT LOCK #4	ANY ACCEPTABLE SOURCE WASHER #4 CAD.			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
81	207602-011	13	WASHER,SPLIT LOCK #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
82	207102-011	12	WASHER,SPLIT LOCK #10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
83							
84	760101-768	8	WASHER-SHOULDER, INSULATING	CIPHER DATA PROD			
85	210008	2	WASHER,WAVE SPRING	SEASTROM 5806-74-1			
86							
87	207607-051	2	NUT, HEX #6 6-32	ANY ACCEPTABLE SOURCE NUT #6 CAD.			
88							
89							
90	**********						
91	160102-001	1	PWR ASSY-POWER SUPPLY	CIPHER DATA PROD		L*2	04-29-83
92	160106-404	1	TOP COVER ASSY-(HT)	CIPHER DATA PROD		L*4	03-31-83

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
1	460107-309	REF	PICTORIAL-CONFIG ASSY, TAPE DRIVE	CIPHER DATA PROD			
2	460100-000	REF	PRODUCT SPECIFICATION-LOW PROFILE TAPE DRIVE	CIPHER DATA PROD			
3	460105-315	REF	OUTLINE DWG-MTT F880	CIPHER DATA PROD			
4							
5							
6	799816-005	1	MANUAL-F880,NEW POWER SUPPLY	CIPHER DATA PROD			
7	160107-452	1	KIT-INSTALLATION HARDWARE 513 CHASSIS/FIXED BOARD	CIPHER DATA PROD			
8	160102-499	1	SHIPPING ASSY	CIPHER DATA PROD			
9							
10	960188-001	1	TAPE DRIVE ASSY-F880, DIECAST	CIPHER DATA PROD			
11	160106-001	1	PWB ASSY-DRIVE/FMTR, DAISY CHAIN	CIPHER DATA PROD			
12	160104-444	1	FRONT PANEL ASSY-(HT)	CIPHER DATA PROD			
13	160107-461	1	HOUSING ASSY-PWR SUPPLY	CIPHER DATA PROD			
14	160104-421	1	HEAD ASSY	CIPHER DATA PROD			
15	160102-451	1	HARNESS ASSY-POWER SWITCH	CIPHER DATA PROD			
16	160102-407	1	AIR DUCT ASSY	CIPHER DATA PROD			
17	160102-477	1	LOGO ASSY	CIPHER DATA PROD			
18							
19							
20	760102-102	1	PWB-VOLTAGE SELECT	CIPHER DATA PROD			
21	960015-001	1	COVER ASSY-PWR SUPPLY HOUSING	CIPHER DATA PROD			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
22	760101-798	1	ADAPTER-DUCT (HT)	CIPHER DATA PROD			
23	760101-794	1	ADAPTER-FILTER	CIPHER DATA PROD			
24	960007-001	1	FILTER-AIR	CIPHER DATA PROD			
25	760101-609	1	NOZZLE-BLOWER	UL-RONCELLT PLASTICS			
26	760106-554	1	DUCT-AIR,TOP PLATE, VACUUM FORMED	CIPHER DATA PROD			
27	760106-555	1	DUCT-AIR,FRONT PANEL, VACUUM FORMED	CIPHER DATA PROD			
28	760101-647	1	SWITCH-POWER,DPST,LIGHTED 16A,250V,UL,CSA,VDE	SEE DRAWING			
29	760105-518	2	LANYARD-ELASTIC	CIPHER DATA PROD			
30	760105-519	1	PIN-SAFETY	CIPHER DATA PROD			
31	760103-547	1	LABEL-NAMEPLATE, MICROSTREAMER,F880	CIPHER DATA PROD			
32	760101-758	1	LABEL-REEL LOADING INST	CIPHER DATA PROD			
33	757004-301	2	LABEL-ZAP (VDE)	CIPHER DATA PROD			
34	- 39 ARE BLANK.						
40	211151-330	1	FUSE-3AG "SLO-BLO" 3AMP	LITTELFUSE 313003			
41							
42	210229-524	6	TY-RAP 1/16 - 1 1/4	THOMAS & BETTS TY-24M			
43	210229-200	1	CLAMP,CABLE-3/16	HEYMAN MANUFACTURING CO. 3303			
44							
45							
46	209994-025	AR	TORQUE SEAL-BLUE	ORGANICS PRODUCTS CO TORQUE SEAL-BL			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
47	209990-075	AR	ADHESIVE-THREAD LOCKING, AEROBIC	VC 3			
48	- 50 ARE BLANK.						
51	213092-408	1	SCREW-SKT HD CAP, 4-40 X 1/2,BLK ONLY	ANY ACCEPTABLE SOURCE			
52	213271-408	4	SCREW-PAN HD,PHIL, 4-40 X 1/2,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
53							
54	213271-605	2	SCREW-PAN HD PHIL 6-32 X 5/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
55	213274-606	1	SCREW-PAN HD,PHIL, 6-32 X 3/8	ANY ACCEPTABLE SOURCE			
56							
57	213271-805	1	SCREW-PAN HD PHIL, 8-32 X 5/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
58							
59	213091-106	4	SCREW-SKT HD CAP, 10-32 X 3/8,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
60							
61	213271-108	4	SCREW-PAN HEAD PHIL, 10-32 X 1/2,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
62							
63							
64	207403-021	5	WASHER-FLAT #4	ANY ACCEPTABLE SOURCE			
65	207605-021	3	WASHER,FLAT #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
66	207801-021	1	WASHER,FLAT #8	NOT ON FILE WASHER #8 CAD			
67	207104-021	8	WASHER, FLAT,#10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
68							
69	207403-011	5	WASHER,SPLIT LOCK #4	ANY ACCEPTABLE SOURCE WASHER #4 CAD.			
70	207602-011	3	WASHER,SPLIT LOCK #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
71	207802-011	1	WASHER,SPLIT LOCK #8	NOT ON FILE WASHER #8 CAD.			
72	207102-011	8	WASHER,SPLIT LOCK #10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			

73 - 83 ARE BLANK.

84 * ITEMS NOT SHOWN ON PICTORIAL CONFIG. ASSY(ITEM 1)ARE:2,3,6,7,8.

85 **********

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
1	460107-303	REF	PICTORIAL-TOP PLATE/ CHASSIS ASSY	CIPHER DATA PROD			
2							
3	160101-417	1	MANUAL UNLOCK ASSY	CIPHER DATA PROD			
4	760105-548	1	BUMPER-RUBBER	CIPHER DATA PROD			
5							
6	160106-408	1	SUPPORT ASSY-TOP PLATE	CIPHER DATA PROD			
7	760106-547	1	TOP PLATE-MTT F880 DIECAST,MACHINING	CIPHER DATA PROD			
8	960071-001	2	SPACER-TEMPLATE	CIPHER DATA PROD			
9	760102-632	1	DEFLECTOR-AIR,DUCT,DIE STAMPED	CIPHER DATA PROD			
10	760101-728	1	REFLECTOR-EOT/BOT	CIPHER DATA PROD			
11							
12							
13	205255-002	1	NUT-HEX,LOCK,10-32	ESNA 22NTM-02			
14	210067-001	4	BEARING-1/4 X 3/8	NMB CORP SSR1F-614ZZEEHA3P25LG-39			
15	209990-076	AR	RETAINING COMPOUND-FAST	LOCTITE 601			
16	209998-067	AR	PRIMER-LOCQUIC,GRADE T	LOCTITE ORDER BY DESC			
17	210116-026	2	FASTENER RETAINER	SOUTHCO INC. 12-11014-26			
18							
19	213599-000	2	SCREW-CAPTIVE,QUICK-OPENING	SOUTHCO INC. 12-11-409-11			
20	210004-006	2	SPRING-COMP.,FASTENER	CENTURY SPRING F-47			
21	213621-606	4	SCREW-SKT SET KNURL CUP PT,6-32 X 3/8,CAD,BLK,ZIN	ANY ACCEPTABLE SOURCE			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
22	209990-107	AR	CONTACT CEMENT-PERMABOND	PEARL CHEMICAL CO 101			
23	210030-250	4	STDOFF-1/4 HEX,1,6-32	AMATOM ELECTRONIC HDW 8220-A-0632			
24	205002-002	1	PIN,GROOV 3/32 X 7/8	DRIVE-LOK,INC. D-093-875			
25	213634-108	1	SCREW-HEX HD,.170 GRIP, 10-32 X 1/2	ANY ACCEPTABLE SOURCE			
26	213274-404	2	SCREW-PAN HD,PHIL 4-40 X 1/4,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
27	213151-107	2	SCREW-FL HD PHIL 100 10-32 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
28	213271-106	6	SCREW-PAN HD PHIL, 10-32 X 3/8,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
29	213271-108	8	SCREW-PAN HEAD PHIL, 10-32 X 1/2,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
30	207403-011	2	WASHER,SPLIT LOCK #4	ANY ACCEPTABLE SOURCE WASHER #4 CAD.			
31	207104-021	12	WASHER, FLAT,#10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
32	207102-011	20	WASHER,SPLIT LOCK #10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
33							
34	960166-001	1	CHASSIS/NARROW-MODIFIED	CIPHER DATA PROD			
35	210103-902	2	SLIDE-CHASSIS	CHASSIS TRACK C1436			
36	760103-535	2	HINGE	CIPHER DATA PROD			
37	210116-027	2	FASTENER-CLIP-ON RECEPT	SOUTHCO INC. 12-11050-27			
38	760101-677	1	LABEL-I/O CONN	CIPHER DATA PROD			
39	209990-071	AR	ADHESIVE-SUPERBONDER	LOCTITE 495			
40	213271-107	4	SCREW-PAN HD,PHIL 10-32 X 7/16,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
41	207101-081	14	NUT, HEX, RADIO PAT. #10 10-32	NUT #10, CAD.			
42	205288-200	2.5	GROMMET STRIP	WECKESSER WG-101			
43	* SPACER,ITEM 8 AND SLIDE,TIEM 35,TO BE MOUNTED IN POSITION 1.						
44	**********						

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
1	460106-322	REF	PICTORIAL-FRONT PANEL ASSY	CIPHER DATA PROD			
2	160101-451	1	DOOR ASSY	CIPHER DATA PROD			
3	760102-595	1	TOUCH SWITCH-TACTILE RESPONSE	CIPHER DATA PROD			
ALT	760102-614		TOUCH SWITCH-ENCAPSULATED	CIPHER DATA PROD			
4	760102-644	1	FRONT PANEL PAINTED	CIPHER DATA PROD			
5	760101-591	4	GUIDE-SPRING	CIPHER DATA PROD			
6	760101-531	1	LATCH-RACK	CIPHER DATA PROD			
7							
8	760101-690	1	PLATE-DOOR,MOLDED	CIPHER DATA PROD			
9	760101-691	1	PLATE-DOOR,MOLDED	CIPHER DATA PROD			
10	210119-018	4	BUMPER-1/2X1/4 HT	MINNESOTA MINING SJ5018			
11	210200-016	2	RING-RETAINING,PUSH-ON	WALDES TRUARC 5115-18-S-PP			
12	205287-006	2	GROMMET-RUBBER	SMITH,HERMAN H. 91114			
13	213271-606	2	SCREW-PAN HEAD PHIL, 6-32 X 3/8,CAD BLK,OR ZIN	ANY ACCEPTABLE SOURCE			
14	207602-011	2	WASHER,SPLIT LOCK #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
15	209990-416	AR	ADHESIVE-LOCTITE 416	LOCTITE 416			
16	210001-013	2	SPRING-COMPRESSION,5 LB	LEE SPRING CO. LC-026C-13			
17	- 20 ARE BLANK.						

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
21	760103-532	1	BLOCK-AIR DUCT	CIPHER DATA PROD			
22							
23	209990-083	AR	CEMENT-PLASTIC	REPLACED BY 17510 3050			
24							
25	**********	***	**********	**********	**********	********	********

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
1	205071-500	1	CONNECTOR-15 POSN	MOLEX,INC. 03-09-1152			
2	205107	1	CONNECTOR-4 POSN	AMP INC. 1-480424-0			
3	205108-115	1	CONN-PC,RT ANGLE,15 PIN W/O FLANGES	MOLEX,INC. 09-02-1152			
4	205108-118	1	CONN-PC,RT ANGLE,18 PIN, W/O FLANGES	MOLEX,INC. 09-02-1182			
5	205108-122	1	CONN-PC,RT ANGLE,22 PIN, W/O FLANGES	MOLEX,INC. 09-02-1222			
6	970122-001	3	CONN-4POS,DISPLACEMENT	AMP INC. 640441-4		07-15-83	L#42
ALT	205122-044		CONN-4 POS LOCK INSUL DISP/PLZD RAMP	MOLEX,INC. 22-26-6042			
7	970121-001	1	CONN-14POS,DISPLACEMENT	AMP INC. 1-640441-4		07-15-83	L#43
ALT	205124-108		CONN-14POS,ID	MOLEX,INC. 22-26-3142			
8	210905	1	#6 LUG-RING	HOLLINGSWORTH TERM. CO. R 2442S			
9	205015	14	TERM-FEM 18-22AWG.093DIA REEL	MOLEX,INC. 02-09-1116			
10	205024	4	CONTACT-SOCKET,LOOSE	AMP INC. 60617-4			
11	210555-036	4	TERM,SLIP-ON.187 TAB,REEL	HOLLINGSWORTH TERM. CO. S05304F-T1			
12	210555-077	2	TERMINAL-NYLON COUPLER 22-18AWG	HOLLINGSWORTH TERM. CO. S05077			
13	210555-078	2	TERMINAL-250X032 MALE,22-18GA,FULLY INSULATED	HOLLINGSWORTH TERM. CO. S05078			
14	210577-104	55	TERM-PC,RT ANGLE,SEL.GOLD	MOLEX,INC. 08-34-0105			
15	210578-100	2	TERMINAL-.093 TAB,NON-INS	AMP INC. 60432-1			
16	760101-729	3	CONTACT-CAPACITIVE PLATE	CIPHER DATA PROD			

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
17	208405-111	55	WIRE,STRD,18AWG,IRPVC,WHT	JUDD WIRE HH0402			
18	208410-111	11	WIRE-STRD,20AWG,IRPVC,WHT	JUDD WIRE HH0317			
19	208415-111	6	WIRE-STRD,22AWG,IRPVC,WHT	JUDD WIRE HH0314			
20							
21	208420-115	52	WIRE-STRD,24AWG,IRPVC,YEL	JUDD WIRE HH0311			
22	208420-116	14	WIRE-STRD,24AWG,IRPVC,BLU	JUDD WIRE HH0311]HH0312]A3445			
23	208405-117	3.3	WIRE-STRD,18AWG,IRPVC,BRN	JUDD WIRE HH0402			
24	208420-118	14	WIRE-STRD,24AWG,IRPVC,ORN	JUDD WIRE HH0311]HH0312]A3445			
25	209999-000	1	MARKER,WIRE- 1-50	ANY ACCEPTABLE SOURCE VMM-0-49			
26	208500-041	3.1	CABLE-SHIELDED,TWO COND	BELDEN 8641			
27	208500-032	2.3	CABLE,STRD,PVC,4COND	ALPHA WIRE CORP. 3203			
28	970123-001	1	CONN-2POS,DISPLACEMENT	AMP INC. 640441-2		07-15-83	L#44
ALT	205070-100		CONN-2 POS LOCK INSUL DISP/PLZD RAMP	MOLEX,INC. 22-26-6022			
29	210575-611	1	PIN-RECEPTACLE (REEL) *	AMP INC. 61119-1			
30	210834-105	1	KEY-POLARIZING	MOLEX,INC. 15-04-9209			
31	210229-527	36	TY-RAP 1/32 - 4.00	PANDUIT PLT1M-MD			
32	205089-001	3	COVER-CONNECTOR,4 POSN	MOLEX,INC. 15-05-8043			
33	210408-006	.4	TUBING HEAT SHRINK, 3/32,BLACK,VW-1	ICO RALLY H1X-3/32		07-15-83	L#45

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
34	208420-117	.4	WIRE-STRD,24AWG,IRPVC,BRN	JUDD WIRE HH0311]HH0312]A3445			
35	208415-112	1.7	WIRE-STRD-22AWG,IRPVC,BLK	JUDD WIRE HH0314			
36	210408-008	.2	TUBING-HEAT SHRINK, 1/8,BLACK,VW-1	ICO RALLY HIX-1/8			
37	205089-002	1	CONNECTOR-COVER,2 POSN	MOLEX,INC. 15-05-8023			
38	210408-003	.1	TUBING-HEAT SHRINK, 3/64,BLACK,VW-1	ICO RALLY HIX-3/64			
39	205287-006	1	GROMMET-RUBBER	SMITH,HERMAN H. 91114		07-15-83	
40	* ITEMS 32 & 37 TO BE USED WITH ITEMS 6 & 28 ALTERNATE PART ONLY						
41	**********						
42	205122-044	3	CONN-4 POS LOCK INSUL DISP/PLZD RAMP	MOLEX,INC. 22-26-6042	L#6		07-14-83
43	205124-108	1	CONN-14POS,ID	MOLEX,INC. 22-26-3142	L#7		07-14-83
44	205070-100	1	CONN-2 POS LOCK INSUL DISP/PLZD RAMP	MOLEX,INC. 22-26-6022	L#28		07-14-83
45	210408-006	.1	TUBING HEAT SHRINK, 3/32,BLACK,VW-1	ICO RALLY H1X-3/32	L#33		07-14-83

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
1	460107-320	REF	PICTORIAL-PWB ASSY,POWER SUPPLY	CIPHER DATA PROD			
2	960026-001	REF	SCHEM-PWB,POWER SUPPLY	CIPHER DATA PROD			
3	731006-800	1	LABEL-ASSY	CIPHER DATA PROD			
4	460100-103	REF	TEST SPECIFICATION-POWER SUPPLY PWB ASSY	CIPHER DATA PROD			
5	760106-104	1	PWB-POWER SUPPLY	CIPHER DATA PROD			
6	201174-160	1	CAP-ELECT.,16000UF,15V	SEE DRAWING 36D163G015AD?A	C3		
7	201174-181	2	CAP-ELECT.,19000 TO 21000UF,40VDC	SEE DRAWING 36DX203G040BC2A	C4,5		
8	201174-250	2	CAP-ELECT,26000 TO 27000UF,30VDC	SEE DRAWING 36DX263G030BC2A	C1,2		
9	205195-200	1	CONNECTOR-SOCKET ASSY, 6 POSN	AMP INC. 350762-4	J5		
10	205064	1	CONNECTOR-9 POSN	MOLEX,INC. 03-09-2092	J6		
11	205070	1	CONNECTOR HOUSING-15 POSN	MOLEX,INC. 03-09-2151	J7		
12	205012	24	TERMINAL,MALE,093 DIA.,PC	MOLEX,INC. 02-09-2134	(SEE-NOTE#36)		
ALT	205012-001		TERMINAL-MALE,.093DIA,PC LOOSE	NOT ON FILE 159-1050P			
13	210982-100	1	KEYING PLUG-INTERCONTACT	AMP INC. 530533-1			
14	202009-751	2	DIODE-RECTIFIER,6A,12V	SEMICON INC SMR750	CR1,2		
15	799025-701	2	RECTIFIER BRIDGE-PC MOUNT	GENERAL INSTRUMENTS KBPC802	U1,2		
16	210195-100	1	RELAY-OPTOISOLATED,P.C.	OPTO 22 P120D3	K1		
17	200093-150	5	RES-FC,1.5K,1W,5%	ALLEN BRADLEY GR1525	R1-5		

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
18	205108-023	1	CONNECTOR-PC EDGE,9 POSN	AMP INC. 531353-7	J9		
19	213271-106	10	SCREW-PAN HD PHIL, 10-32 X 3/8,CAD,BLK,ZINC	ANY ACCEPTABLE SOURCE			
20	207108-021	10	WASHER,FLAT, SMALL OD #10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
21	207105-031	10	WASHER,INTERNAL LOCK #10	ANY ACCEPTABLE SOURCE WASHER #10 CAD.			
22							
23	210555-032	4	TERMINAL-SLIP-ON,.250 TAB	HOLLINGSWORTH TERM. CO. S05300F-T1 OR T2			
24	208405-111	1.3	WIRE,STRD,18AWG,TRPVC,WHT	JUDD WIRE HH0402			
25	208405-112	1.3	WIRE-STED,18AWG,TRPVC,BLK	JUDD WIRE HH0402			
26	205195-300	1	CONNECTOR-SOCKET ASSY, 6 POSN	AMP INC. 350827-1	J8		
27	208405-707	1.3	WIRE-STRD,18AWG,VINYL, TEW,600V,1015,BROWN	JUDD WIRE HU0915			
28	208405-706	1.3	WIRE-STRD,18AWG,VINYL, TEW,600V,1015,BLUE	JUDD WIRE HU0915		02-15-83	L*38
29	208500-620	6	WIRE-JUMPER,16 AWG, 0.500 X 0.250	SQUIRES ELECTRONICS J.0.500X0.250B16		02-15-83	
30	208500-621	1	WIRE-JUMPER,16 AWG, 0.600 X 0.250	SQUIRES ELECTRONICS J.0.600X0.250B16		02-15-83	
31	208500-622	1	WIRE-JUMPER,16 AWG, 0.800 X 0.250	SQUIRES ELECTRONICS J.0.800X0.250B16		02-15-83	
32	208500-623	1	WIRE-JUMPER,16 AWG, 0.900 X 0.250	SQUIRES ELECTRONICS J.0.900X0.250B16		02-15-83	
33	208500-624	1	WIRE-JUMPER,16 AWG, 1.600 X 0.25	SQUIRES ELECTRONICS J.1.600X0.250B16		02-15-83	
34	208500-625	1	WIRE-JUMPER,16 AWG, 1.700 X 0.250	SQUIRES ELECTRONICS J.1.700X0.250B16		02-15-83	
35							
36	* DO NOT MIX TERMINALS ITEM #12 (205012) & ALT PART (205012-001) IN ONE CONNECTOR						
37	**********						

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 DESCRIPTION 2	MFG-NAME MFG-PART#	REF-DES	ST-DATE	END-DATE
38	208500-295	1.3	WIRE BUS TND COPPER 16AWG	ALPHA WIRE CORP. 295		L*28	02-14-83

QTY GIVEN IS NUMBER OF PARTS OR LENGTH OF MATERIAL IN FEET

ITEM	CIPHER PART #	QTY	DESCRIPTION 1 / DESCRIPTION 2	MFG-NAME / MFG-PART#	REF-DES	ST-DATE	END-DATE
1	960057-000	REF	PICTORIAL-TOP COVER ASSY	CIPHER DATA PROD			
2	760104-502	1	TOP COVER	CIPHER DATA PROD			
3	760103-507	2	HINGE-REAR,MOLDED	CIPHER DATA PROD			
4	760101-825	1	DEFLECTOR-TAPE,DIECAST	CIPHER DATA PROD			
5	760102-585	1	BRACKET-TAPE DEFLECTOR, STAMPING	CIPHER DATA PROD			
6	760101-580	1	TAB-COVER LOCK	CIPHER DATA PROD			
7	960052-001	1	LID STAY-RELIEVED	CIPHER DATA PROD			
8	205003-005	1	PIN-GROOVE,.1875 X .625	GROOV-PIN GP24-187X625-14			
9	207402-021	4	WASHER,FLAT #4	ANY ACCEPTABLE SOURCE			
10	207605-021	5	WASHER,FLAT #6	ANY ACCEPTABLE SOURCE WASHER #6 CAD.			
11	213921-404	2	SCREW-PAN HD PHIL,SLF THD TYPE B,4-24X1/4,CAD,BLK,Z	ANY ACCEPTABLE SOURCE			
12	213921-406	4	SCREW-PAN HD PHIL,SLF THD TYPE B,4-24X3/8,CAD,BLK,Z	ANY ACCEPTABLE SOURCE			
13	213921-605	2	SCREW-PAN HD PHIL,SLF THD TYPE B,6-20X5/16,CD,BLK,Z	ANY ACCEPTABLE SOURCE			
14	213921-610	4	SCREW-PAN HD PHIL,SLF THD TYPE B,6-20X5/8,CAD,BLK,Z	ANY ACCEPTABLE SOURCE		03-17-83	L*21
15	210104-911	2	CATCH-ROLLER	HARTWELL CORP. 9-1			
16	- 19 ARE BLANK.						
20	**********						
21	213921-608	4	SCREW-PAN HD PHIL,SLF THD TYPE B,6-20X1/2,CAD,BLK,Z	ANY ACCEPTABLE SOURCE		L*14	03-16-83

SECTION VI

GLOSSARY OF TERMS

AØ -A15 — Address Bus - Tri-State output, active high. Provides the address for memory data exchanges and I/O device data exchanges.

A0 — A Phase - One of two clocks generated by the tachometer. These clocks are used to determine tape speed, direction, and position.

B/A SEL — PIO Port B or A Select (input, active high) - This pin defines which port will be accessed during a data transfer between the Z80-PIO. A low level on this pin selects Port A while a high level selects Port B.

BITCLK — Bit Clock - Used to generate PECLK when both channel two and channel one are dropped. (This condition will cause the Hard Error line to go active during data recovery.)

BLOCK — Block - Term identifying a data record. Block goes active aproximately 15 character times into the preamble.

B0 — B Phase - One of two clocks generated by the tachometer. These clocks are used to determine tape speed, direction, and position.

CS1-CS0 — Channel Select for CTC (input, Active high) - These pins form a 2-bit binary address code for selecting one of the four independent CTC channels for an I/O Write or Read (See truth table below.)

	CS1	CS0
Ch0	0	0
Ch1	0	1
Ch2	1	0
Ch3	1	1

CE* — Chip Enable of CTC (input, Active low) - A low level on this pin enables the CTC to accept control words, Interrupt Vectors, or time constant data words from the Z80 Data Bus during an I/O Read cycle.

C/D Sel	Control or Data Select for PIO (input, active high) - This pin defines the type of data transfer to be performed between the CPU and the PIO. A high level on this pin during a CPU write to the PIO causes the Z80 data bus to be interpreted as a command for the port selected by the B/A Select line. A low level on this pin means that the Z80 data bus is being used to transfer data between the CPU and the PIO. Often Address bit A1 from the CPU will be used for this function.
CDATX	Corrected Data Multiplexed - Data byte that is sent to the output register in serial form.
CHDROP P, Ø-7	Channel Drop - This signal indicates the loss of a data channel for a minimum of 4 character times.
CLK8M	Eight MegaHertz Clock - This clock is used to generate Phase Clock (Ø), One MegaHertz Clock (ØIM), RNOISE, and Write Clock (W2XCLK).
CTCCLKØ	CTC Clock Zero - This clock indicates that tape is in motion. Also indicates forward or reverse direction depending on the tachometer quadrature.
CTCCLK1	CTC Clock 1 - This clock indicates that tape is in motion. Also indicates forward or reverse direction depending on the tachometer quadrature.
CTCZC2	CTC Clock Two - This Clock output from the CTC of approximately 40Hz is used to generate a sawtooth waveform for the compliance arm transducer.
D0-D7	CTC Data Bus of CTC - Tri-state input/output, active high. D0-D7 constitutes an 8-bit bidirectional data bus. The data bus is used for data exchanges with memory and I/O devices.
DATA	Recovered Data - Refers to the nine data lines clocked into the formatter.
DATA P,Ø-7	Data - Refers to the data lines from the read logic to the formatter.
DAVL P, Ø-7	Data Available - Term identifying data is positioned at the read head and is ready to be clocked into the formatter.
~~CDATX~~	Corrected Data Multiplexed - Data byte that is sent to the output register in serial form.
DCLK1	Data Clock 1 - Alternate input to the formatter read clock circuitry. Used in the event of data dropout in Read Channel 2.
DCLK2	Data Clock 2 - Primary input to the formatter read clock circuitry. Synchronizes PE clock to the data rate.

DINLOW — Data In Low - Enables write data to be clocked into the formatter from the controller.

ENFMG — Enable File Mark and Gap - Enables File Mark and Id Burst outputs from the formatter, as well as Block Detect to the Z80.

ENRD — Enable Read - Enables read strobes and data output from the formatter.

FRC 1, 2, 3 — Flux Reversal Control Lines - These lines determine the write formatter mode of operation. The following chart describes how they are used:

Command	FRC1	FRC2	FRC3
Write ID Burst	1	Ø	Ø
Write File Mark	1	Ø	1
Write Data	1	1	1

FSEL — Formatter Select - This signal indicates drive is selected by comparing the unit number of the drive to the IFAD and ITAD lines. FSEL enables drive status information (IONL, IRDY, etc.) to be sent to the controller.

FWD — Forward - This signal indicates forward tape motion to the read formatter logic. When tape is moving in the reverse direction, the read data will be inverted.

HIGH RATE — High Rate - This signal is a phase clock used by the formatter when the drive is selected for 100-ips operation.

INT* — Interrupt Request - Input, active low generated by CTC and PIO. INT* will be serviced by Z80 at the end of the current instruction.

IOREQ* — PIO Input/Output Request from Z80-CPU (input, active low) - The IOREQ* signal is used in conjunction with the B/A Select, C/D Select, CE*, and RD* signals to transfer commands and data between the Z80-CPU and the Z80-PIO. When CE* , RD* and IORQ* are active, the port addressed by B/A will transfer data to the CPU (a read operation). Conversely, when CE* and IORQ* are active but RD* is not active, then the port addressed by B/A will accept from the CPU, either data or control information as specified by the C/D Select signal. Also, if IORQ* and M1* are active simultaneously, the CPU is acknowledging an interrupt and the interrupting port will automatically place its interrupt vector on the CPU data bus if it is the highest device requesting an interrupt.

IS — Supply Servo Current - This signal represents the supply servo current.

IT	Takeup Servo Current - This signal represents the takeup servo current.
LASTW*	Last Word - This signal indicates the last data character to be written is present on the interface. It is also used to terminate the variable length erase operation.
MREQ*	Memory Request - Tri-state output active low signal which indicates that the address bus holds a valid address for a memory read or write operation.
MI*	PIO Machine Cycle One Signal from CPU (input, active low) - This signal from the CPU is used as a sync pulse to control several internal PIO operations. When MI is active and the RD signal is active, the Z80-CPU is fetching an instruction from memory. Conversely, when MI is active and IORQ is active, the CPU is acknowledging an interrupt. In addition, the MI signal has two other functions within the Z80-PIO. 1. MI synchronizes the PIO interrupt logic. 2. When MI occurs without an active RD or IORQ signal the PIO logic enters a reset state.
PECLK	Phase Encode Clock - Clock (22 times the data rate) that is used to synchronize the data in the formatter.
PENAB*	Phase Encode Enable - This signal enables formatter to send read strobes and data information.
POSTCHR	Post Character - This signal identifies detection of the Postamble.
PSEL	Parity Select - This signal gates parity channel from the read logic to the formatter.
PULSE Ø	Pulse Ø - This signal enables the I/O Control register.
PULSE 1	Pulse 1 - This signal sets the on-line flip-flop.
PULSE 2	Pulse 2 - This signal resets the rewind flip-flop.
PULSE 3	Pulse 3 - This signal sets the rewind flip-flop.
PULSE 4	Pulse 4 - This signal resets the on-line flip-flop.
PULSE 5	Pulse 5 - This signal is used to enable the formatter.
PULSE 6	Pulse 6 - This signal trigger is used in the error routine for troubleshooting the drive.
PULSE 7	Pulse 7 - This signal trigger is used in the error routine when outputting RAM to the data bus.

P0A0	PIO input which represents the IREV interface line.
P0A1	PIO input which represents the IWRT interface line.
P0A2	PIO input which represents the IWFM interface line.
P0A3	PIO input which represents the IEDIT interface line.
P0A4	PIO input which represents the IERASE interface line.
P0A5	PIO input which represents the IHISP interface line.
P0A6	Reserved for future use.
P0A7	Reserved for future use.
P0B0	PIO input which represents the IFEN interface line.
P0B1	PIO input which represents the IGO interface line. POASTR* strobes the command into the PIO.
P0B2	PIO output which, when high, selects the 3200 bpi mode of operation.
P0B3	PIO output which, when low, enables the erase head.
P0B4	PIO output which, when low, enables the write head.
P0B5	PIO output which, when high, selects the high speed (100 ips) mode of operation, and when low selects the low speed (25 ips) mode of operation.
P0B6	PIO output which indicates EOF (end of file) or the completion of a write block.
P0B7	PIO output which, when high, selects the normal mode of write operation.
P1A0-P1A7	PIO inputs which represent counter values; P1A0 (LSB), P1A7 (MSB) used by the Z80 to determine tape speed (nominal binary count of 200).
P1B0-P1B1	PIO inputs which are used by the Z80 to determine the tachometer phase.
P1B2-P1B3	PIO outputs which, when active, enable the Z80 to prescale the tachometer for the following speeds:

00: 100 ips

10: 50 ips

11: 25 ips

P1B4-P1B7	PIO inputs which, when active, are used by the Z80 to calculate tape position.
P2A0	PIO input which, when high, indicates no tape in path.
P2A1	PIO input which pulses low to indicate the presence of a write enable ring.
P2A2	PIO input which, when high, indicates that the front panel door or top cover is open.
P2A3	PIO output which, when low, enables the servos.
P2A4	PIO output which, when low, enables the supply servo loop sense.
P2A5	PIO output which, when high, selects the supply servo voltage source.
P2A6	PIO output which, when high, selects the supply servo voltage or current drive.
P2A7	PIO output which, when high, selects the takeup servo voltage or current drive.
P2B0	PIO output which, when high, activates the door lock circuitry.
P2B1	PIO output which, when high, activates the hub lock circuitry.
P2B2	PIO output which, when high, enables +30Vdc to the servo circuits.
P2B3	PIO output which, when low, enables -30Vdc to the servo circuits.
P2B4	PIO output which, when low, activates the blower motor circuitry.
P2B5	PIO output which, when high, deactivates the system failure mechanism.
P2B6-P2B7	PIO outputs which, when high, select one of the following PE write modes of operation: 00: Clear 01: End of File 10: Identification Burst 11: Data Block
P3A0	PIO output which, when high, asserts the ISPEED interface line.
P3A1	Reserved for future use.

P3A2	PIO input which, when high, indicates Gap Detect.
P3A3	PIO input which, when high, represents the IFMK interface line.
P3A4	PIO input which, when high, represents the IONL interface latch.
P3A5	PIO input which, when high, represents the IRWD interface latch.
P3A6	Reserved for future use.
P3A7	PIO input/output which, when low, enables the servo motor shorting relay.
P3BO-P3B4	PI0 outputs which enable the switch panel indicators and the PIO inputs which represent the front panel switches
P3B5	Reserved for future use.
P3B6	PIO output which, when high, enables the RNOISE circuitry.
P3B7	PIO output which, when low, enables the +5Vdc noise injection circuitry.
P_ARDY	This signal indicates the PIO is ready to accept information.
P_ASTR*	This signal clocks PIO causing input information to be latched. When the PIO is enabled an interrupt will occur.
RD*	Memory Read - (Tri-state active low) - RD* indicates that the CPU wants to read data from memory or an I/O device.
RDATA P, 0-7	Read Data - These signals are the nine data lines being read off tape.
RDROP P, 0-7*	Read Drop - This signal indicates the loss of data for a minimum of four character times. Used for block, file mark, and ID Burst detection.
RES*	Reset - Input to the Z80, active low signal that forces program counter to zero and initializes the CPU.
RNOISE	Read Noise - This signal injects a 500-kHz low amplitude signal into the read amplifiers, used for diagnostic firmware.
SCAN P, 0-7	This signal selects which data channel will be multiplexed into the formatter.
SIDR	Supply Input Drive - The drive could be operating on either the current or voltage mode depending upon the feedback enable.
SMDH	Supply Motor Drive High - This signal is used for the supply motor drive voltage.

SMDL	Supply Motor Drive Low - This signal is used for current sense.
STRBX*	This signal enables read strobes and read data from the formatter. Used to disable read strobes when the postamble has been detected.
TIDR	Takeup Input Drive - The drive could be operating in either the current or voltage mode depending upon the feedback mode.
TMDH	Takeup Motor Drive High - This signal is used for the takeup motor drive voltage.
TMDL	Takeup Motor Drive Low - This signal is used for current sense.
VCOM	Read Threshold Voltage - VOUT 0 will change the read threshold during a read or write operation.
VHMON*	Voltage High Minus ON - This signal enables -30 volts to the takeup and supply motors.
VHPON	Voltage High Positive ON - This signal enables +30 volts to the takeup and supply motors.
VIN0	Voltage Input Zero - This signal is input voltage from the EOT sensor.
VIN1	Voltage Input One - This signal is input voltage from the BOT sensor.
VIN2	Voltage Input Two - This signal is input voltage from the compliance arm transducer logic.
VIN3	Voltage Input Three - This signal is used to determine supply servo EMF and voltage.
VIN4	Voltage Input Four - This signal is used to determine takeup servo EMF and voltage.
VIN5	Voltage Input Five - This signal is used to determine supply servo current.
VIN6	Voltage Input Six - This signal is used to determine takeup servo current.
VOUT0	Voltage Output Zero - This signal controls the read threshold voltage.
VOUT1	Voltage Output One - This signal controls the compliance arm offset voltage into the supply servo logic.
VOUT2	Voltage Output Two - This signal is the supply servo voltage control.

VOUT3	Voltage Output Three - This signal is the supply servo current limit control.
VOUT4	Voltage Output Four - This is a takeup servo voltage control.
VOUT5	Voltage Output Five - This is a takeup servo current limit control.
WAIT*	When active (low) this signal causes the Z80 to go into the wait state. The wait state is only used to send or receive data from the DAC.
WR*	Memory Write-Tri-state (active low). This signal indicates that the CPU data Bus (D0 - D7) holds valid data which is to be stored in memory or an I/O device.
WSTROBE	This signal is a clock that latches the write data into the formatter.
W2XCLK	Write 2 Times Clock - This signal clocks the data to the write head.
θ	System Phase Clock - This signal is a two megahertz clock used for the microprocessor circuitry.
θ1M	One Megahertz Clock - This signal is a one megahertz clock used for the microprocessor circuitry.
VIN7	Voltage Input Seven - This signal is used to determine the supply motor offset voltage.
V30P	Voltage 30 Positive - Positive 30Vdc drive voltage for the reel servo circuits (clockwise rotation).
V30M	Voltage 30 Minus - Negative 30Vdc drive voltage for the reel servo circuits (counter-clockwise rotation).
V20P	Voltage 20 Positive - Positive 20Vdc drive voltage for the reel servo circuits (clockwise rotation).
V20M	Voltage 20 Minus - Negative 20Vdc drive voltage for the reel servo circuits (counter-clockwise rotation).
VT	Voltage Takeup - This signal represents the takeup motor voltage feedback.
VS	Voltage Supply - This signal represents the supply motor voltage feedback.
V10P	Voltage 10 Positive - This signal is the positive 10Vdc from the power supply that is used to generate the +5Vdc signal.
V7AC	Voltage 7 Alternating Current - This signal is the AC input for the +5VCC noise injection circuitry.

DAVLX	Data Available Multiplexed - This signal is used to input the serialized data into the skew buffer.
DATA0X	Data Zeroes Multiplexed - This signal represents the serialized data bits input into the skew buffer.
CHDROPX	Channel Dropped Multiplexed - This signal represents the multiplexed channel drop signals.
DROP1	Drop One - This signal indicates that a single channel drop out has occurred.
FERR	Format Error - This signal asserts the IHER line following a parity error or a non-zero character in the postamble.
CHDT	Channel Detect - This signal is true if two or more channels are active and will assert IHER if a gap is not detected following the postamble.
HER*	Hard Error - This signal indicates excessive postamble length.
VRCCHR	Parity - This signal indicates the calculated parity of the byte being transferred to the interface.
DCLK	Data Clock - This signal is synchronized with CDATX data to generate IRSTR.
DOUT	Data Out - This signal is used to enable the output from the skew buffer.